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U.S. Army Center for Health Promotion and Preventive Medicine

USCHPPM

TRAINING MUNITIONS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-00 RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE M33 .50 CALIBER BALL CARTRIDGE

DEPARTMENT OF DEFENSE IDENTIFICATION CODE: A552

Prepared by:

Environmental Health Risk Assessment Program

Prepared for:

U.S. Army Environmental Center

Published date:

15 June 2001

Approved for public release; distribution unlimited

Readiness Thru Health

U.S. Army Center for Health Promotion and Preventive Medicine

The lineage of the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) can be traced back over 50 years. This organization began as the U.S. Army Industrial Hygiene Laboratory, established during the industrial buildup for World War II, under the direct supervision of the Army Surgeon General. Its original location was at the Johns Hopkins School of Hygiene and Public Health. Its mission was to conduct occupational health surveys and investigations within the Department of Defense's (DOD's) industrial production base. It was staffed with three personnel and had a limited annual operating budget of three thousand dollars.

Most recently, it became internationally known as the U.S. Army Environmental Hygiene Agency (AEHA). Its mission expanded to support worldwide preventive medicine programs of the Army, DOD, and other Federal agencies as directed by the Army Medical Command or the Office of The Surgeon General, through consultations, support services, investigations, on-site visits, and training.

On 1 August 1994, AEHA was redesignated the U.S. Army Center for Health Promotion and Preventive Medicine with a provisional status and a commanding general officer. On 1 October 1995, the nonprovisional status was approved with a mission of providing preventive medicine and health promotion leadership, direction, and services for America's Army.

The organization's quest has always been one of excellence and the provision of quality service. Today, its goal is to be an established world-class center of excellence for achieving and maintaining a fit, healthy, and ready force. To achieve that end, the CHPPM holds firmly to its values which are steeped in rich military heritage:

★ *Integrity is the foundation*
★ *Excellence is the standard*
★ *Customer satisfaction is the focus*
★ *Its people are the most valued resource*
★ *Continuous quality improvement is the pathway*

This organization stands on the threshold of even greater challenges and responsibilities. It has been reorganized and reengineered to support the Army of the future. The CHPPM now has three direct support activities located in Fort Meade, Maryland; Fort McPherson, Georgia; and Fitzsimons Army Medical Center, Aurora, Colorado; to provide responsive regional health promotion and preventive medicine support across the U.S. There are also two CHPPM overseas commands in Landstuhl, Germany and Camp Zama, Japan who contribute to the success of CHPPM's increasing global mission. As CHPPM moves into the 21st Century, new programs relating to fitness, health promotion, wellness, and disease surveillance are being added. As always, CHPPM stands firm in its commitment to Army readiness. It is an organization proud of its fine history, yet equally excited about its challenging future.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
06/15/2001	Technical Report	March 1999-August 2001

4. TITLE AND SUBTITLE
Training Munitions Health Risk Assessment No.39-EJ-1485-00
Residential Exposure from Inhalation of the Air Emissions from the M33 .50 Caliber Ball Cartridge , Department of Defesnse Identification Code: A552

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Stafford D.F.R.Coakley, Hsieng-Ye Chang

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Center for Health Promotion and Preventive Medicine
5158 Blackhawk Road
Aberdeen Proving Ground, Maryland 21010-5422

8. PERFORMING ORGANIZATION REPORT NUMBER
Risk Assessment # 39-EJ-1485-00

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Environmental Center
ATTN: SFIM-AEC-PC
Aberdeen Proving Ground, MD 21010-5401

10. SPONSOR/MONITOR'S ACRONYM(S)
USAEC

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
SFIM-AEC-PC-CR-200143

12. DISTRIBUTION/AVAILABILITY STATEMENT
Distribution Unlimited

13. SUPPLEMENTARY NOTES
Point of Contact: Tamera Rush 410-436-6849

14. ABSTRACT
This assessment evaluated the potential for human health effects to offsite residents breathing air emissions following use of the M33 .50 Caliber Ball Cartridge. This document present the evaluation of the potential for adverse human health effects to the offsite residents breathing air emissions following the use of military firing ranges during training exercises. Study results showed no protential for health risks to the hypothetical resident from inhalation of air emissions from the .50 Caliber Cartridge. To conduct this study, air emissions from the .50 Caliber Ball Cartridge were collected in a test chamber (at Aberdeen Test Center, Aberdeen, MD). This information was then used in an air dispersion model to determine ambient air concentrations at a location downwind from the site where the item was activated. Modeled air concentrations were combined with exposure information to estimate the amount of substances the hypothetical resident breathes. This intake was combined with the substance's health information, to determine if there is a potential for health risks from inhjalation of these substances. The health risk included both long-term and short term exposures to the modeled substance concentrations. Study results showed no potential for helath risks from inhalation of air emissions from the .50 Caliber Ball Cartridge

15. SUBJECT TERMS
emissions, aberdeen test center, characterization, health risk, munitions, firing point,

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Tamera Rush
U	U	U	UU		19b. TELEPHONE NUMBER *(Include area code)* 410-436-6849

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REPLY TO
ATTENTION OF

MCHB-TS-EHR

TRAINING MUNITIONS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-00 RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE M33 .50 CALIBER BALL CARTRIDGE

EXECUTIVE SUMMARY

This assessment evaluated the potential for human health effects to offsite residents breathing air emissions following use of the M33 .50 Caliber Ball Cartridge (M33) on firing ranges during training exercises.

To conduct this assessment, air emissions from the M33 were collected in a test chamber at the U.S. Army Aberdeen Test Center, Maryland. The data collected from the Firing Point Emission Study provided the amount and types of substances released from the M33. This information was then used in an air dispersion model to determine ambient air concentrations at a location 100 meters (328 feet) downwind from a site where the M33 may be used. Since the training facility in this assessment is hypothetical, the air model used assumptions that provided conservative estimates of air concentrations.

Modeled air concentrations were combined with exposure information (e.g., number of cartridges used per year) to estimate the amount of each substance the hypothetical offsite resident breathes. This estimate was then compared with the substance's health information, which was obtained from agencies such as the U.S. Environmental Protection Agency, to determine if there is a potential for health effects from inhalation of these substances.

The health risk assessment included both long-term (30 years) and short-term (15-minute or 1-hour) exposures to modeled substance concentrations. Assessment results, generated using conservative methods, showed that the hypothetical offsite resident breathing air as close as 100 meters from the M33 firing location is safe from these emissions. It should be noted that at most training installations, training areas are over 1,000 meters (over half a mile) away from populated areas.

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LIST OF ACRONYMS

AEGL	Acute Exposure Guideline Levels
AIHA	American Industrial Hygiene Association
ATV	Acute Toxicity Value
CO_2	Carbon Dioxide
DODIC	Department of Defense Identification Code
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ERPG	Emergency Response Planning Guidelines
HBSL	Health-Based Screening Level
INPUFF	Integrated PUFF Model
NAAQS	National Ambient Air Quality Standards
NEW	Net Explosive Weight
NH_3	Ammonia
OEL	Occupational Exposure Limit
PM_{10}	Particulate Matter under 10 microns in size
PRG	Preliminary Remediation Goals
RBC	Risk-Based Concentration
RfC	Reference Concentration
TEEL	Temporary Emergency Exposure Limits
TPH	Total Petroleum Hydrocarbon
TSP	Total Suspended Particulates
USAATC	U.S. Army Aberdeen Test Center
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USAEC	U.S. Army Environmental Center

TRAINING MUNITIONS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-00 RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE M33 .50 CALIBER BALL CARTRIDGE

1. PURPOSE

This document presents the assessment of the potential for human health effects to offsite residents breathing air emissions following use of the M33 .50 Caliber Ball Cartridge (M33) on firing ranges during training exercises.

2. AUTHORITY

Memorandum, U.S. Army Environmental Center, 4 June 1999, Subject: Pyrotechnics Risk Assessment.

3. REFERENCES

See Appendix A for a list of references.

4. BACKGROUND

4.1 CARTRIDGES AND THEIR USE

Cartridges are cases that contain a primer, propelling charge, and projectile. The primer is needed to activate the propelling charge, which provides the force to send the projectile to a target. Examples of projectiles include bullets, rockets, and missiles. Cartridges are also referred to as "rounds" and are fired from weapons such as pistols or rifles.

4.2 WHAT IS THE M33?

The M33 is a type of ball ammunition, which means that it is intended for use against unarmored targets. This cartridge is used on firing ranges during training, and in combat. Each cartridge is about as long as a pen and weighs less than half a pound. The M33 does not have any specific markings on either the cartridge case or the bullet. It is generally identified by its plain bullet tip (Reference 1).

The M33 has a brass cartridge case and a bullet with a brass jacket. It also contains a propelling charge that is made up mostly of nitrocellulose. Nitrocellulose is commonly used in the production of lacquers and artificial leathers. It is a primary ingredient in smokeless propellant for both military and commercial use.

4.3 USE OF THE M33

The M33 is fired from .50 caliber machine guns. Each gun is operated differently and is used for different purposes (Reference 2). Therefore, training with the M33 is very important as it teaches our soldiers to operate these different weapons safely and effectively. This will prepare them for combat situations.

4.4 ASSESSMENT SUMMARY

The general assessment approach consisted of two main parts: air dispersion modeling and exposure assessment, which are briefly discussed in the paragraphs below. Sections 5 through 7 present a discussion of the methodology used for this assessment.

Emissions data for the air dispersion modeling were obtained from the Firing Point Emission Study conducted by the U.S. Army Aberdeen Test Center (USAATC) at Aberdeen Proving Ground, Maryland (Reference 3). This study was funded by the U.S. Army Environmental Center (USAEC) with the purpose of identifying and quantifying emissions from weapons firing. Data from this study were generated by firing munitions with weapons that are representative of those used by the U.S. Army during training. Emissions data for the M33 were generated by firing it from the M2 machine gun.

The emissions data for the M33 were used with an atmospheric dispersion model to estimate the average concentrations that may be experienced by an offsite resident. Since this assessment is designed to provide results that would be applicable to most Army training facilities, the training area used in this assessment was a hypothetical one. While most training areas are at least 1,000 meters away from populated areas, as a conservative distance, it was initially assumed that a person could reside 100 meters downwind from the firing point (location where the gun is positioned). In addition, air-modeling parameters were selected to mimic worst-case conditions.

The exposure assessment included calculations of time-averaged concentrations for both long-term (chronic) and short-term (acute) exposures. For the purpose of this assessment, air concentrations were averaged over 30 years for chronic exposures and 1-hour or 15 minutes for acute exposures. Using a screening approach, a substance's estimated time-averaged concentrations were compared to chronic health-based screening levels (HBSLs) established by the U.S. Environmental Protection Agency (EPA) or acute toxicity values (ATVs) established by selected agencies depending on the exposure duration (i.e., 30 years versus 1-hour or 15 minutes). The comparison was made using the ratio of the HBSL or ATV to the estimated air concentration for each of the substances evaluated. If this ratio was less than one, no further evaluation was needed. This approach is conservative because the exposure assumptions used by the agencies, to establish HBSLs and ATVs, are likely to overestimate the exposures experienced by offsite residents living near firing ranges. If the chronic or acute averaged concentrations ($C_{chronic}$ and C_{acute}) were greater than these screening levels, further analysis would be warranted to determine the potential for health effects. Note

that concentrations greater than the screening levels do not indicate an onset of health effects, but rather the potential for such.

5. DATA COLLECTION AND AIR MODELING

5.1 EMISSION FACTORS

Emission factors, used to derive the air modeling emission rates used in this assessment, were generated from the Firing Point Emission Study conducted by the USAATC. This study identified and quantified air emissions from the firing of training munitions. The data the net explosive weight (NEW), the substances sampled, and substance-specific emission factors. Emissions data from the Firing Point Emission Study are included in the first four columns of the table located in Appendix B.

5.2 BACKGROUND AND DESCRIPTION

Air dispersion models are available to mathematically simulate plume behavior and to estimate downwind concentrations of substances emitted from various sources. However, specific models are not available to determine the dispersion of emissions from munitions used during training. Estimating the magnitude and location of these concentrations depends on many factors including the amount and type of emissions, the behavior of the source, and meteorological conditions. Since a specific model is not available for modeling the use of munitions during training, the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) evaluated numerous air models to determine which would be suitable for use with munitions used during training. The USACHPPM recommended using the Integrated PUFF (INPUFF) model to estimate the dispersion of emissions from various munitions (Reference 4).

The INPUFF model (Reference 5) was developed to simulate dispersion from instantaneous or semi-continuous point sources. This Gaussian-integrated puff model is capable of addressing a cloud type release over short periods of time, and computations can be performed for a single point source for multiple receptors. The algorithms used to calculate concentrations assume a vertically uniform wind direction (with no chemical reaction) to compute the contribution of each cloud at a receptor for each time step/interval.

5.3 MODEL ASSUMPTIONS

Some assumptions were made to best represent the firing of M33 cartridges. These assumptions were as follows:

- Typically, with conventional point sources, the cloud rise and formation are determined by characterizing flue gas exit velocity, temperature, and stack diameter. For unconventional sources with no real physical stack dimensions, such as the M2 machine gun, the stack height and diameter were determined to be equal to the height of the barrel and the bore diameter.

No exit velocity was used with this source because the emission rates generated from the test data were obtained from sampling a stabilized cloud with no exit velocity. Table 1 includes the source parameters used to model the M33 cartridges.

TABLE 1: SOURCE PARAMETERS

Parameter	Model Input
Source/Stack Diameter	0.009 meters
Source/Stack Height	1 meter
Source Exit Temperature	298.15 degrees Kelvin (°K) (or 77 °F)
Exit Velocity	0 meters/second
Initial horizontal dispersion coefficient (σ_y)	0.87 meters
Initial vertical dispersion coefficient (σ_z)	1.07 meters

- Initial cloud dimensions are preferred to model the air emissions from these types of releases. Typically, these dimensions are used to define the initial horizontal and vertical dispersion values (σ_y and σ_z) of the released cloud. However, this information was not measured during the studies at the USAATC; therefore, the cloud dimensions were based on the test chamber dimensions and the volume of air sampled. By assuming an elliptical cloud with the prevailing wind direction being perpendicular to the rifle muzzle when fired, the test chamber's radius would be equal to the initial vertical dispersion (σ_z), and the initial horizontal dispersion (σ_y), would be equal to one half the length of the test chamber. The cloud exit temperature was assumed to be equal to the test chamber temperature.

- For the purposes of this assessment, a hypothetical offsite resident was assumed to be located 100 meters directly downwind from the source. The meander of the cloud is a major factor when estimating concentrations at given locations downwind from the source. Assuming that the resident is directly downwind from the source is the same as assuming that there is no cloud meander and the center of the cloud migrates directly over the hypothetical offsite resident. This assumption provides the most conservative modeled concentrations.

- Since this assessment does not look at a specific training site, generic, worst-case meteorological data were used. To determine the worst-case meteorological conditions that would result in the highest air emission concentrations, the modeling was performed using the EPA Risk Management Program Guidance (Reference 6). This guidance includes

tables for estimating the footprint of chemical releases and is intended to inform emergency responders of potential accidental releases. The EPA has defined most default conditions for meteorological modeling parameters. Table 2 lists the meteorological parameters that were used in the air model for the M33.

TABLE 2: WORST-CASE METEOROLOGICAL PARAMETERS

Parameter	Input Value
Wind Speed	1 meter/second
Atmospheric Stability	Category F
Wind Direction	270°
Ambient Temperature	293 degrees Kelvin (°K) (or 68 °F)

5.4 GENERAL METHODOLOGY

The model was run for a total calculation time of 200 seconds to ensure that the total mass of the cloud had passed the worst-case receptor location. Concentrations were calculated every 2 seconds. The model results indicated that the initial cloud reached the hypothetical offsite resident within 70 seconds and dissipated below the lowest concentration the model calculated, which in this instance (1×10^{-11} g/m^3) occurred within 148 seconds. Table 3 contains the air model input parameters used in this assessment.

TABLE 3: AIR MODEL INPUT PARAMETERS

Parameter	Input Value
Number of meteorological periods (NTIME)	1
Duration of each meteorological period (ITIME)	200 seconds
Number of updates to the source (NSRCDS)	100
Duration/time step between each source update (ISUPDT)	2 seconds
Total time modeled/Simulation Period (NTIME)(ITIME)= (NSRCDS)(ISUPDT)	200 seconds

5.5 USE OF MODEL OUTPUT

The concentrations provided by the INPUFF model were based on a unit emission rate of 1 gram/second from an emission source, and did not represent any substance-specific concentrations from the use of any weapons system. This unit emission rate (ER_{unit}) is typically used for ease of modeling purposes. The relationship between the emission rate and predicted concentration is linear. Therefore, the ratio of

the predicted concentration to the unit emission rate was multiplied by each substance-specific emission rate to provide substance-specific concentrations.

5.6 DETERMINATION OF SUBSTANCE-SPECIFIC EMISSION RATES

The actual substance emission rate for one cartridge (ER_1) for each substance was calculated using Equation 1. Example 1 contains a sample calculation using this equation.

$$ER_1 = \frac{EF \cdot CV}{t} \qquad \text{Equation 1}$$

Where:

ER_1 = emission rate for one cartridge [(g/sec)/item]
EF = average adjusted emission factor (lb/item)
CV = conversion factor (453.59 g/lb)
t = release duration as obtained from the INPUFF Model (sec)

Example 1
Sample Calculation Using Equation 1:

$$ER_1 = \frac{(4.99\ E-03)(453.59)}{(2)}$$

= 1.13E+00 g/sec per item

Calculation provided for carbon dioxide (CO_2). Appendix B contains the averaged adjusted emission factor of CO_2 in lb/item.

Substance-specific ambient concentrations for one item (CONC) were calculated using Equation 2. A sample calculation using this equation is provided in Example 2. Appendix B contains the estimated air concentrations.

$$CONC = ER_1 \cdot \frac{UC}{ER_{unit}} \qquad \text{Equation 2}$$

Where:

CONC = substance concentration based on one cartridge (g/m^3)
ER_1 = emission rate for one cartridge (g/sec)
ER_{unit} = unit emission rate as used in the model (g/sec)
UC = concentration based on the unit emission rate (g/m^3)

Example 2
Sample Calculation Using Equation 2:

$$CONC = (1.13E+00)\frac{(1.636E-04)}{(1)}$$

$$= 1.853E\text{-}04\ g/m^3$$

Calculation provided for CO_2.

6. RISK ASSESSMENT

6.1 EXPOSURE ASSUMPTIONS

Exposure assumptions were selected using a typical use scenario for the M33. The typical use scenario was provided by the USAEC and is based on consultation with their senior training advisor (References 7,8). The frequency of use for the M33 was required to determine how much substance an offsite resident would be exposed to in the time period of interest (i.e., acute or chronic exposure). Table 4 summarizes the general use scenario for the M33.

TABLE 4: FREQUENCY OF USE FOR THE M33

Parameter	Values Used
Number of cartridges used per year	6,550
Maximum number of cartridges used in one hour	200

6.2 TIME-AVERAGING

For the chronic assessment, time-averaged concentrations were calculated by assuming that the hypothetical offsite resident would be exposed for 30 years. This is consistent with the exposure duration used by the EPA, which assumes that the resident spends 30 years at the same residence. By using the same exposure duration,

the estimated substance concentrations can be compared with their respective health-based screening levels, which are derived using standard EPA default assumptions.

Using the default residence time established by the EPA, the assumption was made that someone would be exposed to air emissions from 6,550 cartridges per year for 30 years. Table 5 lists the exposure parameters used to estimate concentrations for the chronic assessment. These parameters are based on the typical use scenario provided by USAEC (Table 4) and the assumptions used in the air model run.

TABLE 5: EXPOSURE PARAMETERS USED TO DETERMINE TIME-AVERAGED CHRONIC AIR CONCENTRATIONS

Exposure Parameter	Value Used
Exposure Time (ET_{ctg})	3.33 min/cartridge[1]
Exposure Frequency (EF_{ctg})	6,550 cartridges/year
Exposure Duration (ED)	30 years[2]

[1]Based on the total model time of 200 seconds (3.33 minutes) used in the air model run.
[2]EPA default value.

Chronic averaged concentrations were calculated using Equation 3. Example 3 shows how this calculation was performed, using CO_2 concentration as an example. Since CO_2 is classified as a noncarcinogen, the averaging time (AT) used to calculate the average chronic concentration is the same as the exposure duration.

$$C_{chronic} = \frac{CONC \cdot 10^6 \cdot ET_{ctg} \cdot EF_{ctg} \cdot ED}{525{,}600 \cdot AT} \qquad \text{Equation 3}$$

Where:

$C_{chronic}$ = average chronic concentration (µg/m^3)
CONC = average modeled concentration for one cartridge (g/m^3)
10^6 = unit conversion (µg/g)
ET_{ctg} = exposure time per cartridge (minutes/cartridge)
EF_{ctg} = exposure frequency (cartridges/year)
ED = exposure duration (years)
525,600 = unit conversion (minutes/year)
AT = averaging time (years)
(carcinogenic endpoint: AT = 70 years
noncarcinogenic endpoint: AT = ED)

Example 3
Sample Calculation Using Equation 3:

$$C_{chronic(CO_2)} = \frac{(1.853E-04)(10^6)(3.33)(6,550)(30)}{(525,600)(30)}$$

$$= 7.70E+00\ \mu g/m^3$$

Appendix B contains the average modeled concentration for one cartridge (CONC) and Table 5 provides the exposure parameters.

Unlike the chronic assessment, only limited guidance for evaluating acute exposures is currently available. However, since many cartridges may be fired in a short period of time, acute exposures cannot be overlooked. For the purpose of this assessment, acute exposure is defined as a 1-hour or 15-minute exposure. The 1-hour or 15-minute acute exposure averaging times allow for comparison with guidelines developed specifically for emergency planning purposes (refer to the discussion on acute toxicity below).

The exposure frequency is based on the number of cartridges used per 1-hour or 15 minutes depending on the guideline used for comparison. This information is based on the use scenario provided by the USAEC (Table 4). To estimate air concentrations for potential acute health impacts, it was conservatively assumed that 200 M33 cartridges are fired in one hour. The average acute concentrations were computed using Equation 4. Example 4 contains a sample calculation of this equation.

$$C_{acute} = \frac{CONC \cdot 10^6 \cdot ET_{ctg} \cdot EF_{ctg}}{60} \qquad \text{Equation 4}$$

Where:

C_{acute} = average acute concentration ($\mu g/m^3$)
CONC = average modeled concentration for one cartridge (g/m^3)
10^6 = unit conversion ($\mu g/g$)
ET_{ctg} = exposure time per cartridge (minutes/cartridge)
EF_{ctg} = exposure frequency (cartridges/hour)*
60 = unit conversion (minutes/hour)

* Based on 1 hour or 15 minute (0.25 hour) ATV

Example 4
Sample Calculation Using Equation 4:

$$C_{acute(CO_2)} = \frac{(1.853E-04)(10^6)(3.33)(200)(1/0.25)}{(60)}$$

$$= 8.24E+03\ \mu g/m^3$$

Appendix B provides the average modeled concentration for one cartridge (CONC) for CO_2. Since the acute toxicity value of CO_2 is based on a 15-minute exposure, the average acute concentration of CO_2 was adjusted by a factor of 1/0.25.

6.3 TOXICITY ASSESSMENT

The potential for health effects was determined by comparing time-averaged air concentrations to HBSLs, which are developed from a substance's known toxicity. These toxicity values typically include different levels of safety factors depending on the level of confidence of the critical study. Appendix C contains a table of screening toxicity values used for the chronic and acute assessments.

6.3.1 CHRONIC ASSESSMENT

The chronic assessment was conducted using a screening approach. Using this method, a substance's estimated time-averaged air concentration was compared to its HBSL. If this ratio was less than one, no further analysis was required. This approach is conservative because the exposure frequency (number of exposures per year) used by the EPA to establish the HBSLs assumes that the resident is continuously exposed for 350 days per year (assuming 2 weeks vacation per year). In contrast, exposure to air emissions from actual training activities at a firing range is intermittent and is not likely to occur on a daily basis year round.

A hierarchy of sources was developed for selection of the HBSLs to quantitatively evaluate as many of the identified substances as possible. The hierarchy of sources used was as follows:

- Clean Air Act, EPA National Ambient Air Quality Standards (NAAQS) (Reference 11)
- EPA Region 9 Preliminary Remediation Goals (PRGs) (Reference 10)
- EPA Region 3 Risk-Based Concentrations (RBCs) (Reference 9)

Some substances have neither PRGs nor RBCs because they have their own set of regulatory standards. Under the Clean Air Act, the EPA is required to establish NAAQS for several substances considered harmful to public health and the environment. Currently, NAAQS are available for seven substances. The NAAQS for the longer averaging time were used for the chronic assessment. Depending on the

substance, this can range from an 8-hour average to an annual average. In addition, since the majority of the measured total suspended particulates (TSP) were PM_{10} (particulate matter under 10 microns in size) (Reference 3), the NAAQS for PM_{10} was used to evaluate the potential for health effects from exposure to TSP.

Next on the hierarchy, after the NAAQS, are the EPA Region 9 PRGs and the EPA Region 3 RBCs. Since the methodology used by EPA Region 9 to develop the PRGs generally results in lower values than the EPA Region 3 RBCs, the PRGs were first on the hierarchy of sources. RBCs were used when a PRG was not available. To ensure that the most recent information was used, the Internet sites of both EPA Regions were checked. The HBSLs used for this assessment are presented in Appendix C.

Although the general approach used by both EPA Region 3 and Region 9 is the same, the exposure assumptions differ enough so that final recommended values can vary to a certain degree. In both methods, a substance's screening concentration was selected using the toxicity endpoint that derives a lower concentration. For example, if a substance has a known systemic toxicity and is a carcinogen, the screening concentration was calculated using both toxicity values. To maintain a conservative approach, EPA then selected the lower screening concentration as the recommended PRG or RBC.

Example 5 shows a sample calculation of how a substance's estimated chronic concentration was compared to its HBSL. Since CO_2 does not have an HBSL, ammonia (NH_3) is used as the example substance.

Example 5
Sample Calculation Comparing a Substance's Estimated Chronic Concentration to Its HBSL:

$$\frac{C_{chronic(NH_3)}}{HBSL} = \frac{5.08E-01}{1.04E+02}$$

$$= 4.87E\text{-}03 < 1$$

In this case, the resulting ratio is less than one, indicating further evaluation is not necessary.

Many petroleum hydrocarbons were detected but do not have specific screening levels. Therefore, the approach recommended by the Total Petroleum Hydrocarbon Criteria Working Group (Reference 12) was adopted to evaluate petroleum hydrocarbon mixtures. Based on the working group's assessment of various hydrocarbons, it was recommended that mixtures be separated according to a

substance's number of carbons and its chemical class (i.e., aliphatic or aromatic[1]). Generally, as a substance's carbon number increases, its molecular weight increases, and it is, therefore, not a substance of concern via inhalation. The working group also concluded that aromatic hydrocarbons tend to be more toxic than aliphatic hydrocarbons (Reference 12). Table 6 tabulates the inhalation toxicity values used to evaluate exposure to petroleum mixtures. To be consistent with the methodology used in this assessment, the reference concentrations (RfCs) were converted to PRGs using Region 9 exposure assumptions. The resulting PRGs were used as the HBSLs for the petroleum hydrocarbons in this assessment. These values are presented in Appendix D.

TABLE 6: SUMMARY OF RfCs USED FOR PETROLEUM HYDROCARBONS[1]

Carbon Range	Aromatic Inhalation RfC (mg/m^3)	Aliphatic Inhalation RfC (mg/m^3)
$C_5 - C_6$ $C_{>6} - C_8$		18.4
$C_{>7} - C_8$	0.4	
$C_{>8} - C_{10}$ $C_{>10} - C_{12}$ $C_{>12} - C_{16}$	0.2	1.0
$C_{>16} - C_{21}$ $C_{>21} - C_{35}$	NA	NA

[1]Reference 12
NA = not applicable for high molecular weight TPHs ($C_{>16}$) because substances in this carbon range are not volatile and therefore, inhalation is not a pathway of concern.

6.3.2 ACUTE ASSESSMENT

An established method for assessing acute health effects is not currently available. In 1995 the EPA recognized the need for acute exposure guidelines for emergency response purposes and created the National Advisory Committee for Acute Exposure Guideline Levels (AEGLs) for Hazardous Substances. Currently, AEGLs are available for only a few substances.

To overcome the absence of acute toxicity data, several state regulatory agencies have suggested that guidelines developed for emergency purposes be used in the interim. Although suggestions have been made to use occupational exposure limits (OELs) by applying additional safety factors (References 15, 16), OELs were not used in this assessment because they introduce even more uncertainty than the use of

[1] Aliphatic hydrocarbons are hydrocarbons in which the carbon atoms are joined by single covalent bonds consisting of two shared electrons (e.g., butane). Aromatic hydrocarbons have ring structures (e.g., benzene) (Reference 13).

emergency guidelines. The OELs are designed to protect the workplace environment, and assume 8 hours a day, 5 days a week exposures. By definition, these exposures are more chronic than acute.

In comparison, emergency planning guidelines are more appropriate because they are typically developed for exposures of 1-hour or less. In addition, safety factors are included in the guideline development so that the values would be protective of the general population.

Emergency Response Planning Guidelines (ERPGs) published by the American Industrial Hygiene Association (AIHA) (Reference 15) and the Temporary Emergency Exposure Limits (TEELs) developed by the U.S. Department of Energy (DOE) (Reference 16) were used for this assessment, specifically the ERPG-1s and the TEEL-1s. Since TEEL-1s are intended for exposures up to 15-minutes, air concentrations compared to TEELs were averaged over a 15-minute period. Air concentrations compared to ERPGs and AEGLs were averaged over 1-hour, as these values are intended for 1-hour exposures.

For this study, the hierarchy of sources for ATV selection was as follows with each ATV defined below:

- EPA AEGL-1. "AEGL-1 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure."

- AIHA ERPG-1. "The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor."

- DOE TEEL-1. "The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor."

AEGLs were used first when available since they are developed specifically for the purpose of acute exposure assessments. The ERPGs were selected next, prior to a substance's TEEL, because they are vigorously reviewed before they are published whereas the TEELs are not.

Example 6 shows a sample calculation of how a substance's estimated acute concentration was compared to its ATV.

Example 6
Sample Calculation of Comparing a Substance's Estimated Acute Concentration to Its Acute Toxicity Value:

$$\frac{C_{acute(CO_2)}}{ATV} = \frac{8.24E+03}{5.40E+07}$$

$$= 1.53E\text{-}04 < 1$$

In this example, the ratio is less than one, indicating that further analysis is not necessary.

7. RISK CHARACTERIZATION

As previously described, the exposure assessment included calculations of time-averaged concentrations for both long-term (chronic) and short-term (acute) exposures. Using a screening approach, a substance's estimated time-averaged air concentration was then compared to chronic HBSLs or ATVs. The comparison was made using the ratio of the HBSL or ATV to the estimated concentration. This approach is conservative because the exposure assumptions used by the EPA, to establish HBSLs and ATVs, are likely to overestimate the exposures experienced by offsite residents living near firing ranges.

If this ratio was less than one, no further evaluation was needed. If the chronic or acute averaged concentrations ($C_{chronic}$ and C_{acute}) were greater than the screening levels, resulting in a ratio greater than one, further evaluation would be warranted to determine the potential for health effects. Note that concentrations greater than the screening levels do not indicate an onset of health effects, but rather, the potential for such.

The chronic and acute assessments were conducted as outlined in Section 6.3. Appendix D presents results from the M33 risk characterization.

7.1 CHRONIC HEALTH RISK

The outcome of the chronic assessment indicated that no chronic health effects are expected from breathing the air emissions from the M33. The ratios were for all substances were less than one, indicating no further evaluation was needed.

7.2 ACUTE HEALTH RISK

For the acute assessment, all ratios were below one, indicating that no acute health effects are expected from breathing the air emissions from the M33. Since all ratios for the acute assessment were below one, further evaluation was not necessary.

7.3 FACT SHEET

Appendix E includes a copy of the fact sheet submitted to the USAEC. The fact sheet uses the results from this assessment to address health concerns related to inhalation of M33 air emissions.

8. UNCERTAINTY DISCUSSION

The limitations inherent in modeling and the added conservatism of the assessment contribute to the uncertainty of the assessment results. The risk assessment methodology typically includes safety factors that are embedded in the toxicity data to ensure adequate protection of the general population, particularly, susceptible individuals such as the sick, elderly, and children. Table 7 identifies areas of uncertainty associated with this assessment.

TABLE 7: TYPES OF UNCERTAINTY

Issue	Uncertainty	Direction of Effect
Ambient Air Emissions Modeling		
Modeled versus real-time sampling	The air concentrations in this assessment were modeled. Actual air concentrations taken from the field may be higher or lower.	Varies
Frequency of use for the M33	Actual frequency of use for these munitions during training exercises may be different from those stated in this report.	Varies
Hypothetical offsite resident assumed to be located directly downwind	Unless the area around the training facility is populated, the chances that a person living directly downwind is low.	Overestimates
Use of worst-case meteorological conditions	To ensure that this assessment is applicable to most training areas, worst-case meteorological conditions were used in the air model.	Overestimates
Exposure Assessment		
Estimating time-averaged concentrations	Actual exposure from the M33 is intermittent. If one were to plot a person's exposure profile, the plot would consist of a series of spikes. Since current risk assessment methodology does not allow the evaluation of the potential for health risks as a function of time, a single concentration, averaged over the exposure duration was used. In this assessment, the exposure durations used were 30 years and 1-hour or 15 minutes.	Varies
Comparing estimated concentration to established screening levels	The Region 3 and Region 9 HBSLs were developed assuming that the resident is exposed 350 days a year. It is unlikely for training with the M33 to occur for 350 days a year at a particular firing range.	Overestimates
Comparing estimated concentrations to established screening levels	Comparison to screening levels does not account for possible cumulative effects of exposure to more than one substance.	Underestimates

TABLE 7: TYPES OF UNCERTAINTY

Issue	Uncertainty	Direction of Effect
Screening assessment versus calculating an average daily intake	Calculating an average daily intake allows the use of scenario-specific assumptions. However, unless the ratio of concentration to screening level approaches one, a screening assessment is useful as a first-cut evaluation.	Varies
Exposure to other munitions	Other munitions are typically used during the same training exercise. These items may contain similar or different substances from those detected in the M33.	Underestimates
Toxicity Assessment		
Lack of toxicity data	Some substances were not quantitatively evaluated because they have no known toxicity data.	Underestimates
Modifying and uncertainty factors for toxicity data	Modifying factors and uncertainty factors of varying degree are typically applied to toxicological values. These factors are used to conservatively account for extrapolating from animal studies for human health evaluation, and to conservatively account for variation in human populations.	Overestimates

9. CONCLUSION

Using conservative assumptions, the assessment indicated that offsite residents who live as close as 100 meters directly downwind from training areas are safe from breathing air emissions from the M33. It is believed that the assumptions contained in this analysis are conservative enough to be protective of all the population including the sick, elderly, and children.

10. RECOMMENDATIONS

The results from this assessment are intended for a hypothetical training facility, and may vary depending on site-specific conditions. This assessment used conservative assumptions (e.g., worst-case meteorological conditions, receptor located directly downwind, etc.) and it is believed that most site-specific analyses would result in even lower concentrations. Therefore, the results from this assessment should be applicable to most training facilities, unless site-specific conditions vary significantly.

10. POINT OF CONTACT

Questions about this report may be directed to Ms. Joleen Mobley at (800) 222-9698 (ext 2953) or (410) 436-2953.

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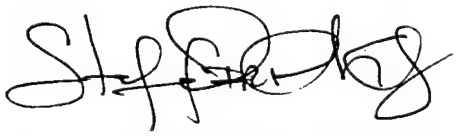

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APPENDIX A

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APPENDIX B

AIR DISPERSION MODELING OUTPUT DATA

Table B-1: Air Modeling Output Data

	Cartridge, 0.50 caliber, Ball, M33 (M2)				Number of Rounds (l):	1	round
	DODIC: A552				Release duration (t):	2	seconds
	Number of items tested =	3			Unit Concentration (UC):	1.636E-04	$(g/m^3)/(g/s)$
	Net Explosive Weight (lbs) =	3.33E-02					
	ATC Firing Test Results[1]						
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/Item) EF	Average Adjusted Emission Factor (lb/lb NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
Permanent Gases							
Ammonia (NH_3)	3.05E+01	NA	3.29E-04	9.89E-03	1.49E-01	1.222E-05	7.47E-02
Carbon Dioxide (CO_2)	4.62E+02	NA	4.99E-03	1.50E-01	2.27E+00	1.853E-04	1.13E+00
Carbon Monoxide (CO)	9.99E+02	NA	1.08E-02	3.25E-01	4.90E+00	4.008E-04	2.45E+00
Oxides of Nitrogen (NOx)	7.20E+01	NA	7.78E-04	2.34E-02	3.53E-01	2.888E-05	1.77E-01
Sulfur Dioxide (SO_2)	2.62E-01	NA	2.83E-06	8.51E-05	1.29E-03	1.051E-07	6.43E-04
Acid Gases							
Hydrogen Fluoride	2.20E-01	2.20E-01	ND	ND	ND	ND	ND
Hydrogen Chloride	2.15E-01	2.10E-01	ND	ND	ND	ND	ND
Hydrogen Bromide	2.10E-01	2.10E-01	ND	ND	ND	ND	ND
Nitric Acid	2.10E-01	2.10E-01	ND	ND	ND	ND	ND
Phosphoric Acid	2.10E-01	2.10E-01	ND	ND	ND	ND	ND
Sulfuric Acid	2.10E-01	2.10E-01	ND	ND	ND	ND	ND
Cyanide							
Particulate Cyanide	9.54E-01	1.10E-02	1.18E-05	3.55E-04	5.36E-03	4.384E-07	2.68E-03
Hydrogen Cyanide	1.33E+01	1.20E-02	1.65E-04	4.96E-03	7.49E-02	6.124E-06	3.74E-02
Particulates							
Total Suspended Particulate	2.59E+01	NA	3.29E-04	9.87E-03	1.49E-01	1.220E-05	7.46E-02
Particulate Matter <10 microns	2.59E+01	NA	3.21E-04	9.64E-03	1.46E-01	1.191E-05	7.28E-02
Particulate Matter <2.5 microns	1.57E+01	NA	1.95E-04	5.86E-03	8.85E-02	7.240E-06	4.43E-02
Metals							
Aluminum	6.18E-02	4.32E-02	7.84E-07	2.36E-05	3.56E-04	2.910E-08	1.78E-04
Antimony	2.68E-01	4.32E-02	3.41E-06	1.02E-04	1.55E-03	1.264E-07	7.73E-04
Arsenic	1.03E-02	4.32E-02	ND	ND	ND	ND	ND
Barium	1.73E-01	4.32E-02	2.20E-06	6.61E-05	9.99E-04	8.169E-08	4.99E-04
Beryllium	4.13E-02	4.32E-02	ND	ND	ND	ND	ND
Cadmium	4.13E-02	4.32E-02	ND	ND	ND	ND	ND
Calcium	3.47E-01	2.27E-01	1.95E-06	5.85E-05	8.84E-04	7.231E-08	4.42E-04

Table B-1: Air Modeling Output Data

	Cartridge, 0.50 caliber, Ball, M33 (M2)				Number of Rounds (l):	1	round
	DODIC: A552				Release duration (t):	2	seconds
	Number of items tested =	3			Unit Concentration (UC):	1.636E-04	$(g/m^3)/(g/s)$
	Net Explosive Weight (lbs) =	3.33E-02					
	ATC Firing Test Results						
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/item) EF	Average Adjusted Emission Factor (lb/lb NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
Chromium	4.13E-02	4.32E-02	ND	ND	ND	ND	ND
Cobalt	4.13E-02	4.32E-02	ND	ND	ND	ND	ND
Copper	3.76E+00	1.08E-01	4.65E-05	1.40E-03	2.11E-02	1.727E-06	1.06E-02
Lead	1.08E+00	4.32E-02	1.37E-05	4.13E-04	6.23E-03	5.096E-07	3.11E-03
Magnesium	4.13E-02	4.32E-02	ND	ND	ND	ND	ND
Manganese	4.13E-02	4.32E-02	ND	ND	ND	ND	ND
Nickel	4.13E-02	4.32E-02	ND	ND	ND	ND	ND
Selenium	1.03E-02	4.32E-02	ND	ND	ND	ND	ND
Silver	4.13E-02	4.32E-02	ND	ND	ND	ND	ND
Thallium	4.13E-02	4.32E-02	ND	ND	ND	ND	ND
Vanadium	4.13E-02	4.32E-02	ND	ND	ND	ND	ND
Zinc	5.35E-01	4.32E-02	6.79E-06	2.04E-04	3.08E-03	2.519E-07	1.54E-03
TO-11 Carbonyls							
Formaldehyde	3.68E-02	1.23E-01	4.58E-07	1.37E-05	2.08E-04	1.698E-08	1.04E-04
Acetaldehyde	1.80E-01	1.80E-01	ND	ND	ND	ND	ND
Acetone	1.19E+00	1.19E+00	ND	ND	ND	ND	ND
Acrolein	2.29E-01	2.29E-01	ND	ND	ND	ND	ND
Proprionaldehyde	2.37E-01	2.37E-01	ND	ND	ND	ND	ND
Crotonaldehyde	2.87E-01	2.87E-01	ND	ND	ND	ND	ND
Butyraldehyde	2.95E-01	2.95E-01	ND	ND	ND	ND	ND
Benzaldehyde	4.34E-01	4.34E-01	ND	ND	ND	ND	ND
Isovaleraldehyde	3.52E-01	3.52E-01	ND	ND	ND	ND	ND
Valeraldehyde	3.52E-01	3.52E-01	ND	ND	ND	ND	ND
o,m,p-Tolualdehyde	4.91E-01	4.91E-01	ND	ND	ND	ND	ND
Hexaldehyde	4.10E-01	4.10E-01	ND	ND	ND	ND	ND
2,5-Dimethylbenzaldehyde	4.10E-01	4.10E-01	ND	ND	ND	ND	ND
VOCs							
Propene	5.68E-02	1.72E-03	7.00E-07	2.10E-05	3.18E-04	2.599E-08	1.59E-04
Dichlorodiflouromethane	3.21E-03	3.46E-03	2.54E-09	7.63E-08	1.15E-06	9.427E-11	5.76E-07

Table B-1: Air Modeling Output Data

	Cartridge, 0.50 caliber, Ball, M33 (M2)				Number of Rounds (I):	1	round
	DODIC: A552				Release duration (t):	2	seconds
	Number of items tested =	3			Unit Concentration (UC):	1.636E-04	$(g/m^3)/(g/s)$
	Net Explosive Weight (lbs) =	3.33E-02					
	ATC Firing Test Results						
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/item) EF	Average Adjusted Emission Factor (lb/lb NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
Chlorodifluoromethane	3.54E-03	3.54E-03	ND	ND	ND	ND	ND
Freon 114	6.99E-03	6.99E-03	ND	ND	ND	ND	ND
Chloromethane	1.65E-03	1.45E-03	4.88E-09	1.47E-07	2.21E-06	1.810E-10	1.11E-06
Vinyl Chloride	2.56E-03	2.56E-03	ND	ND	ND	ND	ND
1,3-Butadiene	1.22E-02	2.21E-03	1.50E-07	4.51E-06	6.81E-05	5.572E-09	3.41E-05
Bromomethane	3.88E-03	3.88E-03	ND	ND	ND	ND	ND
Chloroethane	2.64E-03	2.64E-03	ND	ND	ND	ND	ND
Dichlorofluoromethane	4.21E-03	4.21E-03	ND	ND	ND	ND	ND
Trichloroflouromethane	1.69E-03	1.69E-03	2.70E-09	8.11E-08	1.22E-06	1.001E-10	6.12E-07
Pentane	1.77E-03	2.95E-03	2.21E-08	6.65E-07	1.00E-05	8.218E-10	5.02E-06
Acrolein	2.06E-03	2.29E-03	2.62E-08	7.87E-07	1.19E-05	9.720E-10	5.94E-06
1,1-Dichlorethene	4.05E-03	4.05E-03	ND	ND	ND	ND	ND
Freon 113	7.68E-03	7.68E-03	ND	ND	ND	ND	ND
Acetone	4.56E-01	2.14E-02	5.52E-06	1.66E-04	2.51E-03	2.049E-07	1.25E-03
Methyl Iodide	5.81E-03	5.81E-03	ND	ND	ND	ND	ND
Carbon Disulfide	3.11E-03	3.11E-03	ND	ND	ND	ND	ND
Acetonitrile	1.08E-01	8.39E-03	1.24E-06	3.72E-05	5.61E-04	4.591E-08	2.81E-04
3-Chloropropene	3.13E-03	3.13E-03	ND	ND	ND	ND	ND
Methylene Chloride	2.59E-01	1.95E-01	1.10E-06	3.31E-05	4.99E-04	4.086E-08	2.50E-04
tert-Butyl Alcohol	3.03E-03	3.03E-03	ND	ND	ND	ND	ND
Acrylonitrile	2.17E-02	2.17E-03	2.67E-07	8.02E-06	1.21E-04	9.909E-09	6.06E-05
trans-1,2-Dichloroethene	3.96E-03	3.96E-03	ND	ND	ND	ND	ND
Methyl t-Butyl Ether	3.61E-03	3.61E-03	ND	ND	ND	ND	ND
Hexane	1.37E-01	8.81E-02	7.80E-07	2.34E-05	3.54E-04	2.895E-08	1.77E-04
1,1-Dichloroethane	3.97E-03	3.97E-03	ND	ND	ND	ND	ND
Vinyl Acetate	3.52E-03	3.52E-03	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	3.96E-03	3.96E-03	ND	ND	ND	ND	ND
2-Butanone	1.77E-03	2.95E-03	2.25E-08	6.75E-07	1.02E-05	8.335E-10	5.09E-06
Ethyl Acetate	1.44E-02	3.60E-03	1.75E-07	5.26E-06	7.94E-05	6.493E-09	3.97E-05

Table B-1: Air Modeling Output Data

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	DODIC: A552				Release duration (t):	2	seconds
	Number of items tested =	3			Unit Concentration (UC):	1.636E-04	$(g/m^3)/(g/s)$
	Net Explosive Weight (lbs) =	3.33E-02					
Compound	AFG Firing Test Results				Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/item) EF	Average Adjusted Emission Factor (lb/lb NEW)			
Methyl Acrylate	3.52E-03	3.52E-03	ND	ND	ND	ND	ND
Chloroform	4.88E-03	4.88E-03	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	4.09E-03	5.46E-03	ND	ND	ND	ND	ND
Carbon Tetrachloride	6.29E-03	6.29E-03	ND	ND	ND	ND	ND
1,2-Dichlorethane	5.87E-03	4.05E-03	7.23E-08	2.17E-06	3.28E-05	2.681E-09	1.64E-05
Benzene	3.21E-01	6.39E-04	3.95E-06	1.19E-04	1.79E-03	1.464E-07	8.95E-04
Isooctane	4.67E-03	4.67E-03	ND	ND	ND	ND	ND
Heptane	8.20E-04	4.10E-03	ND	ND	ND	ND	ND
Trichloroethane	4.88E-03	4.88E-03	ND	ND	ND	ND	ND
Ethyl Acrylate	4.09E-03	4.09E-03	ND	ND	ND	ND	ND
1,2-Dichloropropane	4.62E-03	4.62E-03	ND	ND	ND	ND	ND
Methyl Methacrylate	4.09E-03	4.09E-03	ND	ND	ND	ND	ND
Dibromomethane	7.11E-03	7.11E-03	ND	ND	ND	ND	ND
1,4-Dioxane	3.60E-03	3.60E-03	ND	ND	ND	ND	ND
Bromodichloromethane	6.70E-03	6.70E-03	ND	ND	ND	ND	ND
4-Methyl-2-Pentanone	4.10E-03	4.10E-03	ND	ND	ND	ND	ND
Toluene	3.58E-02	3.77E-03	4.03E-07	1.21E-05	1.83E-04	1.496E-08	9.15E-05
Octane	4.67E-03	4.67E-03	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	4.54E-03	4.54E-03	ND	ND	ND	ND	ND
Ethyl Methacrylate	4.67E-03	4.67E-03	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	5.46E-03	5.46E-03	ND	ND	ND	ND	ND
Tertrachloroethene	6.78E-03	6.78E-03	ND	ND	ND	ND	ND
2-Hexanone	4.10E-03	4.10E-03	ND	ND	ND	ND	ND
Dibromochloromethane	8.52E-03	8.52E-03	ND	ND	ND	ND	ND
1,2-Dibromoethane	7.68E-03	7.68E-03	ND	ND	ND	ND	ND
Chlorobenzene	4.60E-03	4.60E-03	ND	ND	ND	ND	ND
1,1,1,2-Tetrachloroethane	6.87E-03	6.87E-03	ND	ND	ND	ND	ND
Ethylbenzene	2.39E-03	4.34E-03	2.96E-08	8.89E-07	1.34E-05	1.098E-09	6.71E-06
m/p-Xylene	4.34E-03	1.30E-03	4.10E-08	1.23E-06	1.86E-05	1.523E-09	9.31E-06

Table B-1: Air Modeling Output Data

	Cartridge, 0.50 caliber, Ball, M33 (M2)				Number of Rounds (l):	1	round
	DODIC: A552				Release duration (t):	2	seconds
	Number of items tested =	3			Unit Concentration (UC):	1.636E-04	$(g/m^3)/(g/s)$
	Net Explosive Weight (lbs) =	3.33E-02					
	Air Firing Test Results						
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/item) EF	Average Adjusted Emission Factor (lb/lb NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
o-Xylene	3.04E-03	4.34E-03	3.79E-08	1.14E-06	1.72E-05	1.405E-09	8.59E-06
Styrene	1.07E-02	4.26E-03	1.32E-07	3.95E-06	5.97E-05	4.885E-09	2.99E-05
Bromoform	1.03E-02	1.03E-02	ND	ND	ND	ND	ND
Cumene	4.92E-03	4.92E-03	ND	ND	ND	ND	ND
1,1,2,2-Tetrachlorethane	6.87E-03	6.87E-03	ND	ND	ND	ND	ND
1,2,3-Trichloropropane	6.03E-03	6.03E-03	ND	ND	ND	ND	ND
Bromobenzene	6.42E-03	6.42E-03	ND	ND	ND	ND	ND
4-Ethyltoluene	4.92E-03	4.92E-03	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	4.92E-03	4.92E-03	ND	ND	ND	ND	ND
Alpha Methyl Styrene	4.83E-03	4.83E-03	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	9.83E-04	4.92E-03	1.25E-08	3.75E-07	5.66E-06	4.631E-10	2.83E-06
1,3-Dichlorobenzene	6.01E-03	6.01E-03	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	6.01E-03	6.01E-03	ND	ND	ND	ND	ND
Benzyl Chloride	5.18E-03	5.18E-03	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	6.01E-03	6.01E-03	ND	ND	ND	ND	ND
Hexachlorethane	9.68E-03	9.68E-03	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	7.42E-03	7.42E-03	ND	ND	ND	ND	ND
Hexachlorobutadiene	1.07E-02	1.07E-02	ND	ND	ND	ND	ND
VOC Tentatively Identified Compounds (TICs)							
Hydrocarbons							
Methane	1.12E+01	1.08E+00	1.27E-04	3.81E-03	5.76E-02	4.708E-06	2.88E-02
Ethylene	3.16E-01	2.29E-02	3.92E-06	1.18E-04	1.78E-03	1.455E-07	8.89E-04
Acetylene	3.54E-02	2.13E-02	4.40E-07	1.32E-05	2.00E-04	1.633E-08	9.98E-05
Ethane	2.15E-01	2.46E-02	2.66E-06	7.99E-05	1.21E-03	9.869E-08	6.03E-04
Propylene	8.37E-02	3.44E-02	1.04E-06	3.12E-05	4.71E-04	3.855E-08	2.36E-04
Propane	3.61E-02	3.61E-02	ND	ND	ND	ND	ND
Propyne	3.20E-02	3.20E-02	ND	ND	ND	ND	ND
Isobutane	4.75E-02	4.75E-02	ND	ND	ND	ND	ND
1-Butene/Isobutylene	9.18E-02	9.18E-02	ND	ND	ND	ND	ND

Table B-1: Air Modeling Output Data

	Cartridge, 0.50 caliber, Ball, M33 (M2)				Number of Rounds (l):	1	round
	DODIC: A552				Release duration (t):	2	seconds
	Number of items tested =	3			Unit Concentration (UC):	1.636E-04	$(g/m^3)/(g/s)$
	Net Explosive Weight (lbs) =	3.33E-02					
	AEC Firing Test Results						
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/item) EF	Average Adjusted Emission Factor (lb/lb NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
1,3-Butadiene/butane	4.59E-02	4.59E-02	ND	ND	ND	ND	ND
cis-butene	4.59E-02	4.59E-02	ND	ND	ND	ND	ND
1-Butyne	4.59E-02	4.59E-02	ND	ND	ND	ND	ND
trans-Butene	4.59E-02	4.59E-02	ND	ND	ND	ND	ND
2-Butyne	4.42E-02	4.42E-02	ND	ND	ND	ND	ND
n-Pentane	5.90E-02	5.90E-02	ND	ND	ND	ND	ND
n-Hexane	7.05E-02	7.05E-02	ND	ND	ND	ND	ND
SVOCs							
N-nitrosodimethylamine	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Bis(2-chloroethyl)ether	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Phenol	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
2-chlorophenol	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
1,3-dichlorobenzene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
1,4-dichlorobenzene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
1,2-dichlorobenzene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Benzyl alcohol	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Bis(2-chloroisopropyl)ether	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
2-methylphenol	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Hexachloroethane	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
N-nitroso-di-n-propylamine	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
4-methylphenol	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Nitrobenzene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Isophorone	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
2-nitrophenol	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
2,4-dimethylphenol	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Bis(2-chloroethoxy)methane	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
2,4-dichlorophenol	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
1,2,4-trichlorobenzene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Naphthalene	1.48E-02	1.86E-02	1.84E-07	5.52E-06	8.34E-05	6.821E-09	4.17E-05

Table B-1: Air Modeling Output Data

	Cartridge, 0.50 caliber, Ball, M33 (M2)				Number of Rounds (I):	1	round
	DODIC: A552				Release duration (t):	2	seconds
	Number of items tested =	3			Unit Concentration (UC):	1.636E-04	$(g/m^3)/(g/s)$
	Net Explosive Weight (lbs) =	3.33E-02					
	ATC Firing Test Results						
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/item) EF	Average Adjusted Emission Factor (lb/lb NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
4-chloroaniline	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Hexachlorobutadiene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
4-chloro-3-methylphenol	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
2-methylnaphthalene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
2,4,6-trichlorophenol	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
2,4,5-trichlorophenol	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
2-chloronaphthalene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
2-nitroaniline	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Acenaphthylene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Dimethylphthalate	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
2,6-dinitrotoluene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Acenaphthene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
3-nitroaniline	3.63E-02	3.71E-02	ND	ND	ND	ND	ND
2,4-dinitrophenol	3.63E-02	3.71E-02	ND	ND	ND	ND	ND
Dibenzofuran	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
2,4-dinitrotoluene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
4-nitrophenol	3.63E-02	3.71E-02	ND	ND	ND	ND	ND
Fluorene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
4-chlorophenyl-phenylether	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Diethylphthalate	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
4-nitroaniline	3.63E-02	3.71E-02	ND	ND	ND	ND	ND
4,6-dinitro-2-methylphenol	3.63E-02	3.71E-02	ND	ND	ND	ND	ND
N-nitrosodiphenylamine(1)	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
4-bromophenyl-phenylether	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Hexachlorobenzene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Pentachlorophenol	3.63E-02	3.71E-02	ND	ND	ND	ND	ND
Phenanthrene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Anthracene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND

Table B-1: Air Modeling Output Data

	Cartridge, 0.50 caliber, Ball, M33 (M2)				Number of Rounds (I):	1	round
	DODIC: A552				Release duration (t):	2	seconds
	Number of items tested =	3			Unit Concentration (UC):	1.636E-04	$(g/m^3)/(g/s)$
	Net Explosive Weight (lbs) =	3.33E-02					
	ATC Firing Test Results						
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/item) EF	Average Adjusted Emission Factor (lb/lb NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
Di-n-butylphthalate	1.67E-02	1.86E-02	2.07E-07	6.23E-06	9.41E-05	7.697E-09	4.70E-05
Fluoranthene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Pyrene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Butylbenzylphthalate	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Benzo(a)anthracene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Chrysene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
3,3-dichlorobenzidine	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate	6.91E-01	2.23E-01	6.31E-06	1.89E-04	2.86E-03	2.340E-07	1.43E-03
Di-n-octylphthalate	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Benzo(a)pyrene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	1.82E-02	1.86E-02	ND	ND	ND	ND	ND
SVOC Tentatively Identified Compounds (TICs)							
TO-13 (PAHs)							
Naphthalene	1.32E-02	2.97E-03	1.31E-07	3.95E-06	5.96E-05	4.875E-09	2.98E-05
Acenaphthylene	5.72E-04	1.86E-05	7.11E-09	2.13E-07	3.22E-06	2.637E-10	1.61E-06
Acenaphthene	1.24E-04	1.86E-05	1.55E-09	4.64E-08	7.01E-07	5.735E-11	3.51E-07
Fluorene	3.18E-04	4.08E-05	3.51E-09	1.05E-07	1.59E-06	1.301E-10	7.96E-07
Phenanthrene	3.72E-04	8.73E-05	3.68E-09	1.11E-07	1.67E-06	1.366E-10	8.35E-07
Anthracene	6.01E-05	1.86E-05	7.44E-10	2.23E-08	3.37E-07	2.760E-11	1.69E-07
Fluoranthene	2.55E-04	1.86E-05	3.15E-09	9.48E-08	1.43E-06	1.171E-10	7.15E-07
Pyrene	6.85E-04	1.86E-05	8.45E-09	2.54E-07	3.83E-06	3.133E-10	1.92E-06
Benzo(a)anthracene	1.41E-04	1.86E-05	1.75E-09	5.25E-08	7.93E-07	6.483E-11	3.96E-07
Chrysene	1.75E-04	1.86E-05	2.16E-09	6.50E-08	9.82E-07	8.029E-11	4.91E-07
Benzo(b)fluoranthene	2.18E-04	1.86E-05	2.71E-09	8.13E-08	1.23E-06	1.004E-10	6.14E-07
Benzo(k)fluoranthene	1.00E-04	1.86E-05	1.24E-09	3.73E-08	5.63E-07	4.601E-11	2.81E-07

Table B-1: Air Modeling Output Data

	Cartridge, 0.50 caliber, Ball, M33 (M2)				Number of Rounds (l):	1	round
	DODIC: A552				Release duration (t):	2	seconds
	Number of items tested =	3			Unit Concentration (UC):	1.636E-04	$(g/m^3)/(g/s)$
	Net Explosive Weight (lbs) =	3.33E-02					
	ATC Firing Test Results						
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/item) EF	Average Adjusted Emission Factor (lb/lb NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
Benzo(e)pyrene	4.45E-04	1.86E-05	5.53E-09	1.66E-07	2.51E-06	2.051E-10	1.25E-06
Benzo(a)pyrene	3.07E-04	1.86E-05	3.84E-09	1.15E-07	1.74E-06	1.425E-10	8.71E-07
Indeno(1,2,3-cd)pyrene	2.46E-04	1.86E-05	3.04E-09	9.14E-08	1.38E-06	1.129E-10	6.90E-07
Dibenz(a,h)anthracene	2.46E-05	1.86E-05	3.04E-10	9.14E-09	1.38E-07	1.129E-11	6.90E-08
Benzo(g,h,i)perylene	1.09E-03	1.86E-05	1.35E-08	4.06E-07	6.13E-06	5.016E-10	3.07E-06
Dioxins and Furans							
2378-Tetrachlorodibenzo-p-dioxin	3.76E-09	3.08E-09	ND	ND	ND	ND	ND
12378-Pentachlorodibenzo-p-dioxin	3.43E-09	3.03E-09	ND	ND	ND	ND	ND
123478-Hexachlorodibenzo-p-dioxin	4.01E-09	3.71E-09	ND	ND	ND	ND	ND
123678-Hexachlorodibenzo-p-dioxin	4.17E-09	3.88E-09	ND	ND	ND	ND	ND
123789-Hexachlorodibenzo-p-dioxin	6.66E-09	6.17E-09	ND	ND	ND	ND	ND
1234678-Heptachlorodibenzo-p-dioxin	1.10E-08	5.48E-09	7.85E-14	2.36E-12	3.56E-11	2.913E-15	1.78E-11
OCDD	1.27E-07	9.04E-08	6.09E-13	1.83E-11	2.76E-10	2.259E-14	1.38E-10
2378-Tetrachlorodibenzo-p-furan	3.58E-09	2.62E-09	ND	ND	ND	ND	ND
12378-Pentachlorodibenzo-p-furan	3.63E-09	3.19E-09	ND	ND	ND	ND	ND
23478-Pentachlorodibenzo-o-furan	2.11E-09	1.85E-09	ND	ND	ND	ND	ND
123478-Hexachlorodibenzo-p-furan	2.98E-09	2.74E-09	ND	ND	ND	ND	ND
123678-Hexachlorodibenzo-p-furan	3.02E-09	2.77E-09	ND	ND	ND	ND	ND
123789-Hexachlorodibenzo-p-furan	2.67E-09	2.53E-09	ND	ND	ND	ND	ND
234678-Hexachlorodibenzo-p-furan	2.10E-09	1.93E-09	ND	ND	ND	ND	ND
1234678-Heptachlorodibenzo-p-furan	2.80E-09	1.84E-09	3.56E-14	1.07E-12	1.61E-11	1.319E-15	8.06E-12
1234789-Heptachlorodibenzo-p-furan	5.89E-09	5.43E-09	ND	ND	ND	ND	ND
OCDF	7.80E-09	5.13E-09	9.90E-14	2.97E-12	4.49E-11	3.674E-15	2.25E-11
Energetics							
Nitrobenzene	3.54E-03	NA	ND	ND	ND	ND	ND
2-Nitrotoluene	3.54E-03	NA	ND	ND	ND	ND	ND
3-Nitrotoluene	3.54E-03	NA	ND	ND	ND	ND	ND
4-Nitrotoluene	3.54E-03	NA	ND	ND	ND	ND	ND
Nitroglycerine	3.54E-03	NA	ND	ND	ND	ND	ND

Table B-1: Air Modeling Output Data

	Cartridge, 0.50 caliber, Ball, M33 (M2)				Number of Rounds (l):	1	round
	DODIC: A552				Release duration (t):	2	seconds
	Number of Items tested =	3			Unit Concentration (UC):	1.636E-04	$(g/m^3)/(g/s)$
	Net Explosive Weight (lbs) =	3.33E-02					
	ATC Firing Test Results[1]						
Compound	Measured Actual Concentration (mg/m^3)	Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb/item) EF	Average Adjusted Emission Factor (lb/lb NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Pollutant Emission Rate for One Item (g/sec) ER_1
1,3-Dinitrobenzene	3.54E-03	NA	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	3.54E-03	NA	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	3.54E-03	NA	ND	ND	ND	ND	ND
1,3,5-Trinitrobenzene	3.54E-03	NA	ND	ND	ND	ND	ND
2,4,6-Trinitrotoluene	3.54E-03	NA	ND	ND	ND	ND	ND
RDX	3.54E-03	NA	ND	ND	ND	ND	ND
4-Amino-2,6-Dinitrotoluene	3.54E-03	NA	ND	ND	ND	ND	ND
2-Amino-4,6-Dinitrotoluene	3.54E-03	NA	ND	ND	ND	ND	ND
Tetryl	3.54E-03	NA	ND	ND	ND	ND	ND
HMX	7.08E-03	NA	ND	ND	ND	ND	ND
Pentaerythritoltetranitrate	7.08E-03	NA	ND	ND	ND	ND	ND
Dibutyl phthalate	1.77E-01	NA	ND	ND	ND	ND	ND
Dioctyl phthalate	1.77E-01	NA	ND	ND	ND	ND	ND
Diphenylamine	8.85E-02	NA	ND	ND	ND	ND	ND

Footnotes:
[1]ATC = Aberdeen Test Center (for additional information on the data, refer to the Firing Point Emission Study)
NA = Not Applicable
ND = Not Detected

APPENDIX C

HEALTH-BASED SCREENING LEVELS AND ACUTE TOXICITY VALUES

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	HBSL ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	AEGL ($\mu g/m^3$)	Source (T or E)	ATV ($\mu g/m^3$)
Permanent Gases											
Ammonia (NH_3)	7664-41-7	1.04E+02	nc	104.39	nc	1.04E+02	1.75E+04	1.75E+04	NA	E	1.75E+04
Carbon Dioxide (CO_2)	124-38-9	NA		NA		NA	NA	5.40E+07	NA	T	5.40E+07
Carbon Monoxide (CO)	630-08-0	1.00E+04	nc	NA		1.00E+04	2.30E+05	2.28E+05	NA	E	2.30E+05
Oxides of Nitrogen (as NO)	10102-43-9	1.00E+02	nc	NA		1.00E+02	NA	3.08E+04	NA	T	3.08E+04
Sulfur Dioxide (SO_2)	7446-09-5	8.00E+01	nc	NA		8.00E+01	7.89E+02	7.86E+02	NA	E	7.89E+02
Acid Gases											
Hydrogen fluoride	7664-39-3	NA		NA		NA	1.60E+03	1.64E+03	NA	E	1.60E+03
Hydrogen chloride	7647-01-0	2.08E+01	nc	2.08E+01	nc	2.08E+01	4.50E+03	4.47E+03	NA	E	4.50E+03
Hydrogen bromide	10035-10-6	NA		NA		NA	NA	9.93E+03	NA	T	9.93E+03
Nitric Acid	7697-37-2	NA		NA		NA	NA	2.58E+03	1.30E+03	A	1.30E+03
Phosphoric acid	7664-38-2	1.04E+01	nc	1.06E+01	nc	1.04E+01	NA	3.00E+03	NA	T	3.00E+03
Sulfuric Acid	7664-93-9	NA		NA		NA	2.00E+03	2.00E+03	NA	E	2.00E+03
Cyanide											
Particulate Cyanide	57-12-5	NA		7.30E+01	nc	7.30E+01	NA	5.00E+03	NA	T	5.00E+03
Hydrogen Cyanide	74-90-8	3.13E+00	nc	3.14E+00	nc	3.13E+00	NA	5.17E+03	NA	T	5.17E+03
Particulates											
Total Suspended Particulate	12789-66-1	5.00E+01	nc	NA		5.00E+01	NA	NA	NA		NA
PM_{10}		5.00E+01	nc	NA		5.00E+01	NA	NA	NA		NA
$PM_{2.5}$		1.50E+01	nc	NA		1.50E+01	NA	NA	NA		NA
Metals											
Aluminum	7429-90-5	5.11E+00	nc	3.65E+00	nc	5.11E+00	NA	3.00E+04	NA	T	3.00E+04
Antimony	7440-36-0	NA		1.46E+00	nc	1.46E+00	NA	1.50E+03	NA	T	1.50E+03
Arsenic	7440-38-2	4.47E-04	c	4.15E-04	c	4.47E-04	NA	3.00E+01	NA	T	3.00E+01
Barium	7440-39-3	5.21E-01	nc	5.11E-01	nc	5.21E-01	NA	1.50E+03	NA	T	1.50E+03
Beryllium	7440-41-7	8.00E-04	c	7.45E-04	c	8.00E-04	NA	5.00E+00	NA	T	5.00E+00
Cadmium	7440-43-9	1.07E-03	c	9.94E-04	c	1.07E-03	NA	3.00E+01	NA	T	3.00E+01
Calcium	7440-70-2	NA		NA	c	NA	NA	3.00E+04	NA	T	3.00E+04
Chromium	7440-47-3		c	1.53E-04	c	1.53E-04	NA	1.50E+03	NA	T	1.50E+03
Cobalt	7440-48-4	NA		2.20E+02	nc	2.20E+02	NA	6.00E+01	NA	T	6.00E+01
Copper	7440-50-8	NA		1.46E+02	nc	1.46E+02	NA	3.00E+03	NA	T	3.00E+03
Lead	7439-92-1	1.50E+00	nc	NA		1.50E+00	NA	1.50E+02	NA	T	1.50E+02
Magnesium	7439-95-4	NA		NA		NA	NA	3.00E+04	NA	T	3.00E+04
Manganese	7439-96-5	5.11E-02	nc	5.22E-02	nc	5.11E-02	NA	3.00E+03	NA	T	3.00E+03
Nickel	7440-02-0	NA		7.30E+01	nc	7.30E+01	NA	3.00E+03	NA	T	3.00E+03

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	HBSL ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	AEGL ($\mu g/m^3$)	Source (T or E)	ATV ($\mu g/m^3$)
Selenium	7782-49-2	NA		1.83E+01	nc	1.83E+01	NA	6.00E+02	NA	T	6.00E+02
Silver	7740-22-4	NA		1.83E+01	nc	1.83E+01	NA	3.00E+02	NA	T	3.00E+02
Thallium	7440-28-0	NA		2.56E-01	nc	2.56E-01	NA	3.00E+02	NA	T	3.00E+02
Vanadium	7440-62-2	NA		2.56E+01	nc	2.56E+01	NA	1.50E+02	NA	T	1.50E+02
Zinc	7440-66-6	NA		1.10E+03	nc	1.10E+03	NA	3.00E+04	NA	T	3.00E+04
TO-11 Carbonyls											
Formaldehyde	50-00-0	1.48E-01	c	1.39E-01	c	1.48E-01	1.23E+03	1.23E+03	NA	E	1.23E+03
Acetaldehyde	75-07-0	8.73E-01	c	8.13E-01	c	8.73E-01	1.80E+04	1.80E+04	NA	E	1.80E+04
Acetone	67-64-1	3.65E+02	nc	3.65E+02	nc	3.65E+02	NA	2.37E+06	NA	T	2.37E+06
Acrolein	107-02-8	2.09E-02	nc	2.08E-02	nc	2.09E-02	2.30E+02	2.29E+02	NA	E	2.30E+02
Proprionaldehyde	123-38-6	NA		NA		NA	NA	7.50E+04	NA	T	7.50E+04
Crotonaldehyde	4170-30-3	3.54E-03	c	3.30E-03	c	3.54E-03	5.72E+03	5.72E+03	NA	E	5.72E+03
Butyraldehyde	123-72-8	NA		NA		NA	NA	7.38E+04	NA	T	7.38E+04
Benzaldehyde	100-52-7	3.65E+02	nc	3.65E+02	nc	3.65E+02	NA	1.50E+04	NA	T	1.50E+04
Isovaleraldehyde	590-86-3	NA		NA		NA	NA	NA	NA		NA
Valeraldehyde	110-62-3	NA		NA		NA	NA	NA	NA		NA
o,m,p-Tolualdehyde	1334-78-7	NA		NA		NA	NA	NA	NA		NA
Hexaldehyde	66-25-1	NA		NA		NA	NA	NA	NA		NA
2,5-Dimethylbenzaldehyde	5779-94-2	NA		NA		NA	NA	NA	NA		NA
VOCs											
Propene	115-07-1	NA		NA		NA	NA	NA	NA		NA
Dichlorodifluoromethane	75-71-8	2.09E+02	nc	1.83E+02	nc	2.09E+02	NA	1.48E+07		T	1.48E+07
Chlorodifluoromethane	75-45-6	5.11E+04	nc	5.11E+04	nc	5.11E+04	NA	4.41E+06		T	4.41E+06
Freon 114	76-14-2	NA		NA		NA	NA	2.10E+07		T	2.10E+07
Chloromethane	74-87-3	1.07E+00	c	1.79E+00	c	1.07E+00	NA	2.06E+05		T	2.06E+05
Vinyl Chloride	75-01-4	2.20E-02	c	2.10E-02	c	2.20E-02	NA	1.28E+04		T	1.28E+04
1,3-Butadiene	106-99-0	3.74E-03	c	3.48E-03	c	3.74E-03	2.20E+04	2.21E+04		E	2.20E+04
Bromomethane	74-83-9	5.21E+00	nc	5.11E+00	nc	5.21E+00	NA	5.82E+04		T	5.82E+04
Chloroethane	75-00-3	2.32E+00	nc	NA		2.32E+00	NA	2.64E+06		T	2.64E+06
Dichlorofluoromethane	75-71-8	2.09E+02	nc	1.83E+02	nc	2.09E+02	NA	1.48E+07		T	1.48E+07
Trichlorofluoromethane	75-69-4	7.30E+02	nc	7.30E+02	nc	7.30E+02	NA	2.81E+06		T	2.81E+06
Pentane	109-66-0	NA		NA		NA	NA	1.80E+06		T	1.80E+06
Acrolein	107-02-8	2.09E-02	nc	2.08E-02	nc	2.09E-02	2.30E+02	2.29E+02		E	2.30E+02
1,1-Dichloroethene	75-35-4	5.21E+02	nc	5.11E+02	nc	5.21E+02	NA	7.92E+04		T	7.92E+04
Freon 113	76-13-1	3.13E+04	nc	3.14E+04	nc	3.13E+04	NA	9.58E+06		T	9.58E+06
Acetone	67-64-1	3.65E+02	nc	3.65E+02	nc	3.65E+02	NA	2.37E+06		T	2.37E+06

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	HBSL ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	AEGL ($\mu g/m^3$)	Source (T or E)	ATV ($\mu g/m^3$)
Methyl Iodide	74-88-4	NA		NA		NA	145000	1.45E+05		E	1.45E+05
Carbon Disulfide	75-15-0	7.30E+02	nc	7.30E+02	nc	7.30E+02	NA	3.11E+04		T	3.11E+04
Acetonitrile	75-05-8	6.20E+01	nc	6.21E+01	nc	6.20E+01	NA	1.01E+05		T	1.01E+05
3-Chloropropene	107-05-1	1.04E+00	nc	NA		1.04E+00	9.39E+03	9.39E+03		E	9.39E+03
Methylene Chloride	75-09-2	4.09E+00	c	3.79E+00	c	4.09E+00	696000	6.94E+05		E	6.96E+05
tert-Butyl Alcohol	75-65-0	NA		NA		NA	NA	4.55E+05		T	4.55E+05
Acrylonitrile	107-13-1	2.83E-02	c	2.61E-02	c	2.83E-02	21700	2.17E+04		E	2.17E+04
trans-1,2-Dichloroethene	156-60-5	7.30E+01	nc	7.30E+01	nc	7.30E+01	NA	4.95E+04		T	4.95E+04
Methyl t-Butyl Ether	1634-04-4	3.13E+03	nc	3.13E+03	nc	3.13E+03	NA	4.32E+05		T	4.32E+05
Hexane	110-54-3	2.09E+02	nc	2.08E+02	nc	2.09E+02	NA	5.28E+05		T	5.28E+05
1,1-Dichloroethane	75-34-3	5.21E+02	nc	5.11E+02	nc	5.21E+02	NA	1.21E+06		T	1.21E+06
Vinyl Acetate	108-05-4	2.09E+02	nc	2.08E+02	nc	2.09E+02	19150	1.76E+04		E	1.92E+04
cis-1,2-Dichloroethene	156-59-2	3.65E+01	nc	3.65E+01	nc	3.65E+01	NA	7.92E+05		T	7.92E+05
2-Butanone	78-93-3	1.04E+03	nc	1.04E+03	nc	1.04E+03	NA	8.85E+05		T	8.85E+05
Ethyl Acetate	141-78-6	3.29E+03	nc	3.29E+03	nc	3.29E+03	NA	1.44E+06		T	1.44E+06
Methyl Acrylate	96-33-3	1.10E+02	nc	1.10E+02	nc	1.10E+02	NA	NA			NA
Chloroform	67-66-3	8.35E-02	c	7.73E-02	c	8.35E-02	NA	9.76E+03		T	9.76E+03
1,1,1-Trichloroethane	71-55-6	1.04E+03	nc	2.30E+03	nc	1.04E+03	1.94E+06	1.91E+06		E	1.94E+06
Carbon Tetrachloride	56-23-5	1.28E-01	c	1.18E-01	c	1.28E-01	1.28E+05	1.26E+05		E	1.28E+05
1,2-Dichloroethane	107-06-2	7.39E-02	c	6.88E-02	c	7.39E-02	NA	8.08E+03		T	8.08E+03
Benzene	71-43-2	2.49E-01	c	2.16E-01	c	2.49E-01	1.56E+05	1.60E+05		E	1.56E+05
Isooctane (2,2,4-trimethylpentane)	540-84-1	NA		NA		NA	NA	3.50E+05		T	3.50E+05
Heptane	142-82-5	NA		NA		NA	NA	1.80E+06		T	1.80E+06
Trichloroethane	71-55-6	1.04E+03	nc	2.30E+03	nc	1.04E+03	1.94E+06	1.91E+06		E	1.94E+06
Ethyl Acrylate	140-88-5	1.40E-01	c	NA		1.40E-01	NA	6.14E+04		T	6.14E+04
1,2-Dichloropropane	78-87-5	9.89E-02	c	9.21E-02	c	9.89E-02	NA	5.08E+05		T	5.08E+05
Methyl Methacrylate	80-62-6	7.30E+02	nc	7.30E+02	nc	7.30E+02	NA	4.09E+05		T	4.09E+05
Dibromomethane	74-95-3	3.65E+01	nc	3.65E+01	nc	3.65E+01	NA	2.50E+05		T	2.50E+05
1,4-Dioxane	123-91-1	6.11E-01	c	5.69E-01	c	6.11E-01	NA	9.00E+04		T	9.00E+04
Bromodichloromethane	75-27-4	1.08E-01	c	1.01E-01	c	1.08E-01	NA	4.00E+03		T	4.00E+03
4-Methyl-2-Pentanone	108-10-1	8.34E+01	nc	7.30E+01	nc	8.34E+01	NA	3.07E+05		T	3.07E+05
Toluene	108-88-3	4.02E+02	nc	4.16E+02	nc	4.02E+02	1.88E+05	1.89E+05		E	1.88E+05
Octane	111-65-9	NA		NA		NA	NA	NA			NA
trans-1,3-Dichloropropene	10061-02-6	5.17E-02	c	4.82E-02	c	5.17E-02	NA	NA			NA
Ethyl Methacrylate	97-63-2	3.29E+02	nc	3.29E+02	nc	3.29E+02	NA	NA			NA
1,1,2-Trichloroethane	79-00-5	1.20E-01	c	1.12E-01	c	1.20E-01	NA	1.64E+05		T	1.64E+05

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	HBSL ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	AEGL ($\mu g/m^3$)	Source (T or E)	ATV ($\mu g/m^3$)
Tetrachloroethene	127-18-4	3.31E+00	c	3.13E+00	c	3.31E+00	NA	6.78E+05		T	6.78E+05
2-Hexanone	591-78-6	NA		5.11E+00	nc	5.11E+00	NA	4.09E+04		T	4.09E+04
Dibromochloromethane	124-48-1	8.00E-02	c	7.45E-02	c	8.00E-02	NA	6.00E+03		T	6.00E+03
1,2-Dibromoethane	106-93-4	8.73E-03	c	8.24E-03	c	8.73E-03	NA	1.54E+05		T	1.54E+05
Chlorobenzene	108-90-7	6.21E+01	nc	6.21E+01	nc	6.21E+01	NA	1.38E+05		T	1.38E+05
1,1,1,2-Tetrachloroethane	630-20-6	2.60E-01	c	2.41E-01	c	2.60E-01	NA	5.15E+04		T	5.15E+04
Ethylbenzene	100-41-4	1.06E+03	nc	1.06E+03	nc	1.06E+03	NA	5.43E+05		T	5.43E+05
m&p-Xylene	108-38-3 106-42-3	7.30E+02	nc	7.30E+03	nc	7.30E+02	NA	6.51E+05		T	6.51E+05
o-Xylene	95-47-6	7.30E+02	nc	7.30E+03	nc	7.30E+02	NA	6.51E+05		T	6.51E+05
Styrene	100-42-5	1.06E+03	nc	1.04E+03	nc	1.06E+03	2.13E+05	2.13E+05		E	2.13E+05
Bromoform	75-25-2	1.75E+00	c	1.61E+00	c	1.75E+00	NA	6.20E+03		T	6.20E+03
Cumene	98-82-8	4.02E+02	nc	4.02E+02	nc	4.02E+02	NA	2.46E+05		T	2.46E+05
1,1,2,2-Tetrachloroethane	79-34-5	3.31E-02	c	3.13E-02	c	3.31E-02	NA	2.06E+04		T	2.06E+04
1,2,3-Trichloropropane	96-18-4	9.61E-04	c	3.13E-03	c	9.61E-04	NA	6.03E+04		T	6.03E+04
Bromobenzene	108-86-1	1.04E+01	nc	NA		1.04E+01	NA	4.82E+04		T	4.82E+04
4-Ethyltoluene	622-96-8	NA		NA		NA	NA	1.25E+05		T	1.25E+05
1,3,5-Trimethylbenzene	108-67-8	6.21E+00	nc	6.21E+00	nc	6.21E+00	NA	3.68E+05		T	3.68E+05
Alpha Methyl Styrene	98-83-9	2.56E+02	nc	2.56E+02	nc	2.56E+02	NA	NA			NA
1,2,4-Trimethylbenzene	95-63-6	6.21E+00	nc	6.21E+00	nc	6.21E+00	NA	1.80E+05		T	1.80E+05
1,3-Dichlorobenzene	541-73-1	3.29E+00	nc	3.29E+00	nc	3.29E+00	NA	3.61E+04		T	3.61E+04
1,4-Dichlorobenzene	106-46-7	3.06E-01	c	2.85E-01	c	3.06E-01		6.61E+05		T	6.61E+05
Benzyl Chloride	100-44-7	3.96E-02	c	3.68E-02	c	3.96E-02	5.20E+03	5.17E+03		E	5.20E+03
1,2-Dichlorobenzene	95-50-1	2.09E+02	nc	3.29E+01	nc	2.09E+02	NA	3.01E+05		T	3.01E+05
Hexachlorethane	67-72-1	4.80E-01	c	4.47E-01	c	4.80E-01	NA	2.90E+04		T	2.90E+04
1,2,4-Trichlorobenzene	120-82-1	2.08E+02	nc	2.08E+02	nc	2.08E+02	NA	3.71E+04		T	3.71E+04
Hexachlorobutadiene	87-68-3	8.73E-02	c	8.03E-02	c	8.73E-02	3.21E+04	3.20E+04		E	3.21E+04
Hydrocarbons											
Methane	74-82-8	NA		NA		NA	NA	3.30E+06		T	3.30E+06
Ethylene	74-85-1	NA		NA		NA	NA	4.60E+05		T	4.60E+05
Acetylene	74-86-2	NA		NA		NA	NA	NA			NA
Ethane	74-84-0	NA		NA		NA	NA	NA			NA
Propylene	115-07-1	NA		NA		NA	NA	NA			NA
Propane	74-98-6	NA		NA		NA	NA	3.78E+06		T	3.78E+06
Propyne (methyl acetylene)	74-99-7	NA		NA		NA	NA	2.79E+06		T	2.79E+06

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	HBSL ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	AEGL ($\mu g/m^3$)	Source (T or E)	ATV ($\mu g/m^3$)
Isobutane	75-28-5	NA		NA		NA	NA	9.52E+05		T	9.52E+05
1-Butene/Isobutylene (115-11-7)	106-98-9	NA		NA		NA	NA	6.87E+06		T	6.87E+06
1,3-Butadiene/butane	106-99-0	3.74E-03	c	3.48E-03	c	3.74E-03	2.20E+04	2.21E+04		E	2.20E+04
cis-butene	25167-67-3	NA		NA		NA	NA	1.72E+04	NA	T	1.72E+04
1-Butyne	107-00-6	NA		NA		NA	NA	NA			NA
trans-Butene	25167-67-3	NA		NA		NA	NA	1.72E+04	NA	T	1.72E+04
2-Butyne (crotonylene)	503-17-3	NA		NA		NA	NA	NA			NA
n-Pentane	109-66-0	NA		NA		NA	NA	1.80E+06		T	1.80E+06
n-Hexane	110-54-3	2.10E+02	nc	2.08E+02	nc	2.10E+02	NA	5.28E+05		T	5.28E+05
SVOCs											
n-nitrosodimethylamine	62-75-9	1.37E-04	c	1.23E-04	c	1.37E-04	NA	2.50E+03		T	2.50E+03
bis(2-chloroethyl)ether	111-44-4	5.82E-03	c	5.69E-03	c	5.82E-03	NA	5.85E+04		T	5.85E+04
phenol	108-95-2	2.19E+03	nc	2.19E+03	nc	2.19E+03	NA	3.85E+04		T	3.85E+04
2-chlorophenol	95-57-8	1.83E+01	nc	1.83E+01	nc	1.83E+01	NA	5.25E+03		T	5.25E+03
1,3-Dichlorobenzene	541-73-1	3.29E+00	nc	3.29E+00	nc	3.29E+00	NA	3.61E+04		T	3.61E+04
1,4-dichlorobenzene	106-46-7	3.06E-01	c	2.85E-01	c	3.06E-01	NA	6.61E+05		T	6.61E+05
1,2-dichlorobenzene	95-50-1	2.09E+02	nc	3.29E+01	nc	2.09E+02	NA	3.01E+05		T	3.01E+05
benzyl alcohol	100-51-6	1.10E+03	nc	1.10E+03	nc	1.10E+03	NA	5.53E+04		T	5.53E+04
bis(2-chloroisopropyl)ether	108-60-1	1.92E-01	c	1.79E-01	c	1.92E-01	NA	6.99E+04		T	6.99E+04
2-methylphenol	95-48-7	1.83E+02	nc	1.83E+02	nc	1.83E+02	NA	NA			NA
hexachloroethane	67-72-1	4.80E-01	c	4.47E-01	c	4.80E-01	NA	2.90E+04		T	2.90E+04
n-nitroso-di-n-propylamine	621-64-7	9.61E-04	c	8.94E-04	c	9.61E-04	NA	2.00E+02		T	2.00E+02
4-methylphenol	106-44-5	1.83E+02	nc	1.83E+02	nc	1.83E+02	NA	NA			NA
nitrobenzene	98-95-3	2.09E+00	nc	2.19E+00	nc	2.09E+00	NA	1.51E+04		T	1.51E+04
isophorone	78-59-1	7.08E+00	c	6.59E+00	c	7.08E+00	NA	2.83E+04		T	2.83E+04
2-nitrophenol	88-75-5	NA		NA		NA	NA	NA			NA
2,4-dimethylphenol	105-67-9	7.30E+01	nc	7.30E+01	nc	7.30E+01	NA	NA			NA
bis(2-chloroethoxy)methane	111-91-1	NA		NA		NA	NA	NA			NA
2,4-dichlorophenol	120-83-2	1.10E+01	nc	1.10E+01	nc	1.10E+01	NA	3.00E+04		T	3.00E+04
1,2,4-trichlorobenzene	120-82-1	2.08E+02	nc	2.08E+02	nc	2.08E+02	NA	3.71E+04		T	3.71E+04
naphthalene	91-20-3	3.13E+00	nc	3.29E+00	nc	3.13E+00	NA	7.86E+04		T	7.86E+04
4-chloroaniline	106-47-8	1.46E+01	nc	1.46E+01	nc	1.46E+01	NA	3.00E+04		T	3.00E+04
hexachlorobutadiene	87-68-3	8.62E-02	c	8.03E-02	c	8.62E-02	3.21E+04	3.20E+04		E	3.21E+04
4-chloro-3-methylphenol	59-50-7	NA		NA		NA	NA	2.00E+04		T	2.00E+04
2-methylnaphthalene	91-57-6	NA		7.30E+01	nc	7.30E+01	NA	2.00E+04		T	2.00E+04
hexachlorocyclopentadiene	77-47-4	7.30E-02	nc	7.30E-02	nc	7.30E-02	NA	2.23E+02		T	2.23E+02

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	HBSL ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	AEGL ($\mu g/m^3$)	Source (T or E)	ATV ($\mu g/m^3$)
2,4,6-trichlorophenol	88-06-2	1.10E+02	nc	1.10E+02	nc	1.10E+02	NA	3.00E+04		T	3.00E+04
2,4,5-trichlorophenol	95-95-4	3.65E+02	nc	3.65E+02	nc	3.65E+02	NA	3.00E+04		T	3.00E+04
2-chloronaphthalene	91-58-7	2.92E+02	nc	2.92E+02	nc	2.92E+02	NA	6.00E+02		T	6.00E+02
2-nitroaniline	88-74-4	2.09E-01	nc	2.08E-01	nc	2.09E-01	NA	NA			NA
Acenaphthylene	208-96-8	NA		NA		NA	NA	2.00E+02		T	2.00E+02
dimethylphthalate	131-11-3	3.65E+04	nc	3.65E+04	nc	3.65E+04	NA	1.50E+04		T	1.50E+04
2,6-dinitrotoluene	606-20-2	3.65E+00	nc	3.65E+00	nc	3.65E+00	NA	6.00E+02		T	6.00E+02
acenaphthene	83-32-9	2.19E+02	nc	2.19E+02	nc	2.19E+02	NA	1.25E+03		T	1.25E+03
3-nitroaniline	99-09-2	NA		NA		NA	NA	NA			NA
2,4-dinitrophenol	51-28-5	7.30E+00	nc	7.30E+00	nc	7.30E+00	NA	7.50E+03		T	7.50E+03
dibenzofuran	132-64-9	1.46E+01	nc	1.46E+01	nc	1.46E+01	NA	NA			NA
2,4-dinitrotoluene	121-14-2	7.30E+00	nc	7.30E+00	nc	7.30E+00	NA	6.00E+02		T	6.00E+02
4-nitrophenol	100-02-7	2.92E+01	nc	2.92E+01	nc	2.92E+01	NA	3.00E+04		T	3.00E+04
Fluorene	86-73-7	1.46E+02	nc	1.46E+02	nc	1.46E+02	NA	7.50E+04		T	7.50E+04
4-chlorophenyl-phenylether	7005-72-3	NA		NA		NA	NA	NA			NA
diethylphthalate	84-66-2	2.92E+03	nc	2.92E+03	nc	2.92E+03	NA	1.50E+04		T	1.50E+04
4-nitroaniline	100-01-6	NA		NA		NA	NA	9.00E+03		T	9.00E+03
4,6-dinitro-2-methylphenol	534-52-1	NA		3.65E-01	nc	3.65E-01	NA	5.00E+02		T	5.00E+02
n-nitrosodiphenylamine(1)	86-30-6	1.37E+00	c	1.28E+00	c	1.37E+00	NA	NA			NA
4-bromophenyl-phenylether	101-55-3	NA		NA		NA	NA	NA			NA
hexachlorobenzene	118-74-1	4.18E-03	c	3.91E-03	c	4.18E-03	NA	7.50E+01		T	7.50E+01
pentachlorophenol	87-86-5	5.60E-02	c	5.22E-02	c	5.60E-02	NA	1.50E+03		T	1.50E+03
phenanthrene	85-01-8	NA		NA		NA	NA	2.00E+03		T	2.00E+03
anthracene	120-12-7	1.10E+03	nc	1.10E+03	nc	1.10E+03	NA	6.00E+03		T	6.00E+03
di-n-butylphthalate	84-74-2	3.65E+02	nc	3.65E+02	nc	3.65E+02	NA	1.50E+04		T	1.50E+04
fluoranthene	206-44-0	1.46E+02	nc	1.46E+02	nc	1.46E+02	NA	3.00E+01		T	3.00E+01
pyrene	129-00-0	1.10E+02	nc	1.10E+02	nc	1.10E+02	NA	1.50E+04		T	1.50E+04
butylbenzylphthalate	85-68-7	7.30E+02	nc	7.30E+02	nc	7.30E+02	NA	5.00E+05		T	5.00E+05
benzo(a)anthracene	56-55-3	2.17E-02	c	8.58E-03	c	2.17E-02	NA	6.00E+02		T	6.00E+02
chrysene	218-01-9	2.17E+00	c	8.58E-01	c	2.17E+00	NA	2.00E+02		T	2.00E+02
3,3-dichlorobenzidine	91-94-1	1.50E-02	c	1.39E-02	c	1.50E-02	NA	6.21E+03		T	6.21E+03
bis(2-ethylhexyl)phthalate	117-81-7	4.80E-01	c	4.47E-01	c	4.80E-01	NA	1.00E+04		T	1.00E+04
di-n-octylphthalate	117-84-0	7.30E+01	nc	7.30E+01	nc	7.30E+01	NA	1.50E+05		T	1.50E+05
benzo(b)fluoranthene	205-99-2	2.17E-02	c	8.58E-03	c	2.17E-02	NA	NA			NA
benzo(k)fluoranthene	207-08-9	2.17E-01	c	8.58E-02	c	2.17E-01	NA	NA			NA
benzo(a)pyrene	50-32-8	2.17E-03	c	2.02E-03	c	2.17E-03	NA	7.50E+03		T	7.50E+03

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	HBSL ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	AEGL ($\mu g/m^3$)	Source (T or E)	ATV ($\mu g/m^3$)
indeno(1,2,3-cd)pyrene	193-39-5	2.17E-02	c	8.58E-03	c	2.17E-02	NA	NA			NA
dibenz(a,h)anthracene	53-70-3	2.17E-03	c	8.58E-04	c	2.17E-03	NA	3.00E+04		T	3.00E+04
benzo(g,h,i)perylene	191-24-2	NA		NA		NA	NA	3.00E+04		T	3.00E+04
TO-13 (PAHs)											
naphthalene	91-20-3	3.13E+00	nc	3.29E+00	nc	3.13E+00	NA	7.86E+04		T	7.86E+04
acenaphthylene	208-96-8	NA		NA		NA	NA	2.00E+02		T	2.00E+02
Acenaphthene	83-32-9	2.19E+02	nc	2.19E+02	nc	2.19E+02	NA	1.25E+03		T	1.25E+03
fluorene	86-73-7	1.46E+02	nc	1.46E+02	nc	1.46E+02	NA	7.50E+04		T	7.50E+04
phenanthrene	85-01-8	NA		NA		NA	NA	2.00E+03		T	2.00E+03
anthracene	120-12-7	1.10E+03	nc	1.10E+03	nc	1.10E+03	NA	6.00E+03		T	6.00E+03
fluoranthene	206-44-0	1.46E+02	nc	1.46E+02	nc	1.46E+02	NA	3.00E+01		T	3.00E+01
pyrene	129-00-0	1.10E+02	nc	1.10E+02	nc	1.10E+02	NA	1.50E+04		T	1.50E+04
benzo(a)anthracene	56-55-3	2.17E-02	c	8.58E-03	c	2.17E-02	NA	6.00E+02		T	6.00E+02
chrysene	218-01-9	2.17E+00	c	8.58E-01	c	2.17E+00	NA	2.00E+02		T	2.00E+02
benzo(b)fluoranthene	205-99-2	2.17E-02	c	8.58E-03	c	2.17E-02	NA	NA			NA
benzo(k)fluoranthene	207-08-9	2.17E-01	c	8.58E-02	c	2.17E-01	NA	NA			NA
Benzo(e)pyrene	192-97-2	NA		NA		NA	NA	NA	NA		NA
benzo(a)pyrene	50-32-8	2.17E-03	c	2.02E-03	c	2.17E-03	NA	7.50E+03		T	7.50E+03
indeno(1,2,3-cd)pyrene	193-39-5	2.17E-02	c	8.58E-03	c	2.17E-02	NA	NA			NA
dibenz(a,h)anthracene	53-70-3	2.17E-03	c	8.58E-04	c	2.17E-03	NA	3.00E+04		T	3.00E+04
benzo(g,h,i)perylene	191-24-2	NA		NA		NA	NA	3.00E+04		T	3.00E+04
Dioxins and Furans											
2378-Tetrachlorodibenzo-p-dioxin	1746-01-6	4.48E-08	c	4.17E-08	c	4.48E-08	NA	3.50E+00		T	3.50E+00
12378-Pentachlorodibenzo-p-dioxin	40321-76-4	NA		NA		NA	NA	2.50E+00		T	2.50E+00
123478-Hexachlorodibenzo-p-dioxin	39227-28-6	NA		NA		NA	NA	NA			NA
123678-Hexachlorodibenzo-p-dioxin	57653-85-7	NA		NA		NA	NA	1.50E+01		T	1.50E+01
123789-Hexachlorodibenzo-p-dioxin	19408-74-3	1.48E-06	c	1.38E-06	c	1.48E-06	NA	NA			NA
1234678-Heptachlorodibenzo-p-dioxin	35822-46-9	NA		NA		NA	NA	NA			NA
Octachlorodibenzo(p)dioxin	3268-87-9	NA		NA		NA	NA	1.50E+02		T	1.50E+02
2378-Tetrachlorodibenzo-p-furan	51207-31-9	NA		NA		NA	NA	2.00E+00		T	2.00E+00
12378-Pentachlorodibenzo-p-furan	57117-41-6	NA		NA		NA	NA	NA			NA
23478-Pentachlorodibenzo-o-furan	57117-31-4	NA		NA		NA	NA	7.50E-02		T	7.50E-02
123478-Hexachlorodibenzo-p-furan	70648-26-9	NA		NA		NA	NA	7.50E+00		T	7.50E+00
123678-Hexachlorodibenzo-p-furan	57117-44-9	NA		NA		NA	NA	2.50E+00		T	2.50E+00
123789-Hexachlorodibenzo-p-furan	72918-21-9	NA		NA		NA	NA	NA			NA

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

Compound	CAS #	Region 9 PRG ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	Region 3 RBC ($\mu g/m^3$)	Toxicity Endpoint (c or nc)	HBSL ($\mu g/m^3$)	ERPG ($\mu g/m^3$)	TEEL ($\mu g/m^3$)	AEGL ($\mu g/m^3$)	Source (T or E)	ATV ($\mu g/m^3$)
234678-Hexachlorodibenzo-p-furan	60851-34-5	NA		NA		NA	NA	1.50E+00		T	1.50E+00
1234678-Heptachlorodibenzo-p-furan	67562-39-4	NA		NA		NA	NA	NA			NA
1234789-Heptachlorodibenzo-p-furan	55673-89-7	NA		NA		NA	NA	NA			NA
Octachlorodibenzofuran	39001-02-0	NA		NA		NA	NA	3.00E+02		T	3.00E+02
Energetics											
Nitrobenzene	98-95-3	2.09E+00	nc	2.19E+00	nc	2.09E+00	NA	1.51E+04		T	1.51E+04
2-Nitrotoluene	88-72-2	3.65E+01	nc	3.65E+01	nc	3.65E+01	NA	NA			NA
3-Nitrotoluene	99-08-1	3.65E+01	nc	7.30E+01	nc	3.65E+01	NA	NA			NA
4-Nitrotoluene	99-99-0	3.65E+01	nc	3.65E+01	nc	3.65E+01	NA	3.37E+04		T	3.37E+04
Nitroglycerine	55-63-0	4.80E-01	c	4.47E-01	c	4.80E-01	NA	NA			NA
1,3-Dinitrobenzene	99-65-0	3.65E-01	nc	3.65E-01	nc	3.65E-01	NA	3.00E+03		T	3.00E+03
2,6-Dinitrotoluene	606-20-2	3.65E+00	nc	3.65E+00	nc	3.65E+00	NA	6.00E+02		T	6.00E+02
2,4-Dinitrotoluene	121-14-2	7.30E+00	nc	7.30E+00	nc	7.30E+00	NA	6.00E+02	NA	T	6.00E+02
1,3,5-Trinitrobenzene	99-35-4	1.10E+02	nc	1.10E+02	nc	1.10E+02	NA	3.00E+04		T	3.00E+04
2,4,6-Trinitrotoluene	118-96-7	2.24E-01	c	2.09E-01	c	2.24E-01	NA	2.50E+04		T	2.50E+04
RDX	121-82-4	6.11E-02	c	5.69E-02	c	6.11E-02	NA	NA			NA
4-Amino-2,6-Dinitrotoluene	19406-51-0	NA		NA		NA	NA	NA			NA
2-Amino-2,6-Dinitrotoluene	35572-78-2	NA		NA		NA	NA	1.50E+04		T	1.50E+04
Tetryl	479-45-8	3.65E+01	nc	3.65E+01	nc	3.65E+01	NA	NA			NA
HMX	2691-41-0	1.83E+02	nc	1.83E+02	nc	1.83E+02	NA	NA			NA
Pentaerythritoltetranitrate	78-11-5	NA		NA		NA	NA	5.00E+01		T	5.00E+01
Dibutyl Phthalate	84-74-2	3.65E+02	nc	3.65E+02	nc	3.65E+02	NA	1.50E+04		T	1.50E+04
Dioctyl Phthalate	117-81-7	4.80E-01	c	4.47E-01	c	4.80E-01	NA	1.00E+04		T	1.00E+04
Diphenylamine	122-39-4	9.13E+01	nc	9.13E+01	nc	9.13E+01	NA	3.00E+04		T	3.00E+04

Footnotes:
PRG: Preliminary Remediation Goals
c = cancer
nc = non-cancer
RBC: Risk-Based Concentration
HBSL: Health-Based Screening Level
(E) ERPG: Emergency Response Planning Guidelines
(T) TEEL: Temporary Emergency Exposure Limits
(A) AEGL: Acute Exposure Guideline Level
ATV: Acute Toxicity Value
NA: Not Available

APPENDIX D

RISK ASSESSMENT DATA

Table D-1: Comparison of Air Concentrations With Health-Based Values

Compound	Cartridge, 0.50 caliber, Ball, M33 (M2) DODIC: A552							
	$C_{chronic}$ ($\mu g/m^3$)	Health-Based Screening Level ($\mu g/m^3$)	$C_{chronic}$/ HBSL	> 1?	C_{acute} ($\mu g/m^3$)	Acute Toxicity Value ($\mu g/m^3$)	C_{acute}/ ATV	> 1?
Permanent Gases								
Ammonia (NH3)	5.08E-01	1.04E+02	4.87E-03	no	1.36E+02	1.75E+04	7.76E-03	no
Carbon Dioxide (CO2)	7.70E+00	NV		na	8.24E+03	5.40E+07	1.53E-04	no
Carbon Monoxide (CO)	1.67E+01	1.00E+04	1.67E-03	no	4.45E+03	2.30E+05	1.94E-02	no
Oxides of Nitrogen (as NO)	1.20E+00	1.00E+02	1.20E-02	no	1.28E+03	3.08E+04	4.17E-02	no
Sulfur Dioxide (SO2)	4.37E-03	8.00E+01	5.46E-05	no	1.17E+00	7.89E+02	1.48E-03	no
Acid Gases								
Hydrogen fluoride	NA	NV		na	NA	1.60E+03		na
Hydrogen chloride	NA	2.08E+01		na	NA	4.50E+03		na
Hydrogen bromide	NA	NV		na	NA	9.93E+03		na
Nitric Acid	NA	NV		na	NA	1.30E+03		na
Phosphoric acid	NA	1.04E+01		na	NA	3.00E+03		na
Sulfuric Acid	NA	NV		na	NA	2.00E+03		na
Cyanide								
Particulate Cyanide	1.82E-02	7.30E+01	2.49E-04	no	1.95E+01	5.00E+03	3.90E-03	no
Hydrogen Cyanide	2.54E-01	3.13E+00	8.13E-02	no	2.72E+02	5.17E+03	5.26E-02	no
Particulates								
Total Suspended Particulate	5.07E-01	5.00E+01	1.01E-02	no	1.36E+02	NA		na
PM10	4.95E-01	5.00E+01	9.89E-03	no	1.32E+02	NA		na
PM2.5	3.01E-01	1.50E+01	2.00E-02	no	8.04E+01	NA		na
Metals								
Aluminum	1.21E-03	5.11E+00	2.37E-04	no	1.29E+00	3.00E+04	4.31E-05	no
Antimony	5.25E-03	1.46E+00	3.60E-03	no	5.62E+00	1.50E+03	3.75E-03	no
Arsenic	NA	4.47E-04		na	NA	3.00E+01		na
Barium	3.39E-03	5.21E-01	6.51E-03	no	3.63E+00	1.50E+03	2.42E-03	no
Beryllium	NA	8.00E-04		na	NA	5.00E+00		na
Cadmium	NA	1.07E-03		na	NA	3.00E+01		na
Calcium	3.00E-03	NV		na	3.21E+00	3.00E+04	1.07E-04	no
Chromium	NA	1.53E-04		na	NA	1.50E+03		na
Cobalt	NA	2.20E+02		na	NA	6.00E+01		na
Copper	7.17E-02	1.46E+02	4.91E-04	no	7.67E+01	3.00E+03	2.56E-02	no
Lead	2.12E-02	1.50E+00	1.41E-02	no	2.26E+01	1.50E+02	1.51E-01	no

Table D-1: Comparison of Air Concentrations With Health-Based Values

Compound	Cartridge, 0.50 caliber, Ball, M33 (M2) DODIC: A552							
	$C_{chronic}$ (µg/m^3)	Health-Based Screening Level (µg/m^3)	$C_{chronic}$/ HBSL	> 1?	C_{acute} (µg/m^3)	Acute Toxicity Value (µg/m^3)	C_{acute}/ ATV	> 1?
Magnesium	NA	NV		na	NA	3.00E+04		na
Manganese	NA	5.11E-02		na	NA	3.00E+03		na
Nickel	NA	7.30E+01		na	NA	3.00E+03		na
Selenium	NA	1.83E+01		na	NA	6.00E+02		na
Silver	NA	1.83E+01		na	NA	3.00E+02		na
Thallium	NA	2.56E-01		na	NA	3.00E+02		na
Vanadium	NA	2.56E+01		na	NA	1.50E+02		na
Zinc	1.05E-02	1.10E+03	9.56E-06	no	1.12E+01	3.00E+04	3.73E-04	no
TO-11 Carbonyls								
Formaldehyde	3.02E-04	1.48E-01	2.05E-03	no	1.89E-01	1.23E+03	1.53E-04	no
Acetaldehyde	NA	8.73E-01		na	NA	1.80E+04		na
Acetone	NA	3.65E+02		na	NA	2.37E+06		na
Acrolein	NA	2.09E-02		na	NA	2.30E+02		na
Proprionaldehyde	NA	NV		na	NA	7.50E+04		na
Crotonaldehyde	NA	3.54E-03		na	NA	5.72E+03		na
Butyraldehyde	NA	NV		na	NA	7.38E+04		na
Benzaldehyde	NA	3.65E+02		na	NA	1.50E+04		na
Isovaleraldehyde	NA	NV		na	NA	NA		na
Valeraldehyde	NA	NV		na	NA	NA		na
o,m,p-Tolualdehyde	NA	NV		na	NA	NA		na
Hexaldehyde	NA	NV		na	NA	NA		na
2,5-Dimethylbenzaldehyde	NA	NV		na	NA	NA		na
VOCs								
Propene	1.08E-03	NV		na	2.89E-01	NA		na
Dichlorodifluoromethane	3.92E-06	2.09E+02	1.88E-08	no	4.19E-03	1.48E+07	2.83E-10	no
Chlorodifluoromethane	NA	5.11E+04		na	NA	4.41E+06		na
Freon 114	NA	NV		na	NA	2.10E+07		na
Chloromethane	3.22E-06	1.07E+00	3.02E-06	no	8.04E-03	2.06E+05	3.91E-08	no
Vinyl Chloride	NA	2.20E-02		na	NA	1.28E+04		na
1,3-Butadiene	9.92E-05	3.74E-03	2.66E-02	no	6.19E-02	2.20E+04	2.81E-06	no
Bromomethane	NA	5.21E+00		na	NA	5.82E+04		na
Chloroethane	NA	2.32E+00		na	NA	2.64E+06		na

Table D-1: Comparison of Air Concentrations With Health-Based Values

	Cartridge, 0.50 caliber, Ball, M33 (M2) DODIC: A552							
Compound	$C_{chronic}$ ($\mu g/m^3$)	Health-Based Screening Level ($\mu g/m^3$)	$C_{chronic}$/ HBSL	> 1?	C_{acute} ($\mu g/m^3$)	Acute Toxicity Value ($\mu g/m^3$)	C_{acute}/ ATV	> 1?
Dichlorofluoromethane	NA	2.09E+02		na	NA	1.48E+07		na
Trichlorofluoromethane	4.16E-06	7.30E+02	5.70E-09	no	4.45E-03	2.81E+06	1.59E-09	no
Pentane	3.41E-05	NV		na	3.65E-02	1.80E+06	2.03E-08	no
Acrolein	4.04E-05	2.09E-02	1.94E-03	no	1.08E-02	2.30E+02	4.70E-05	no
1,1-Dichloroethene	NA	5.21E+02		na	NA	7.92E+04		na
Freon 113	NA	3.13E+04		na	NA	9.58E+06		na
Acetone	8.51E-03	3.65E+02	2.33E-05	no	9.11E+00	2.37E+06	3.84E-06	no
Methyl Iodide	NA	NV		na	NA	1.45E+05		na
Carbon Disulfide	NA	7.30E+02		na	NA	3.11E+04		na
Acetonitrile	1.91E-03	6.20E+01	3.08E-05	no	2.04E+00	1.01E+05	2.02E-05	no
3-Chloropropene	NA	1.04E+00		na	NA	9.39E+03		na
Methylene Chloride	7.27E-04	4.09E+00	1.78E-04	no	4.54E-01	6.96E+05	6.52E-07	no
tert-Butyl Alcohol	NA	NV		na	NA	4.55E+05		na
Acrylonitrile	1.76E-04	2.83E-02	6.24E-03	no	1.10E-01	2.17E+04	5.07E-06	no
trans-1,2-Dichloroethene	NA	7.30E+01		na	NA	4.95E+04		na
Methyl t-Butyl Ether	NA	3.13E+03		na	NA	4.32E+05		na
Hexane	1.20E-03	2.09E+02	5.77E-06	no	1.29E+00	5.28E+05	2.44E-06	no
1,1-Dichloroethane	NA	5.21E+02		na	NA	1.21E+06		na
Vinyl Acetate	NA	2.09E+02		na	NA	1.92E+04		na
cis-1,2-Dichloroethene	NA	3.65E+01		na	NA	7.92E+05		na
2-Butanone	3.46E-05	1.04E+03	3.32E-08	no	3.70E-02	8.85E+05	4.19E-08	no
Ethyl Acetate	2.70E-04	3.29E+03	8.21E-08	no	2.89E-01	1.44E+06	2.00E-07	no
Methyl Acrylate	NA	1.10E+02		na	NA	NA		na
Chloroform	NA	8.35E-02		na	NA	9.76E+03		na
1,1,1-Trichloroethane	NA	1.04E+03		na	NA	1.94E+06		na
Carbon Tetrachloride	NA	1.28E-01		na	NA	1.28E+05		na
1,2-Dichloroethane	4.77E-05	7.39E-02	6.46E-04	no	1.19E-01	8.08E+03	1.47E-05	no
Benzene	2.61E-03	2.49E-01	1.05E-02	no	1.63E+00	1.56E+05	1.04E-05	no
Isooctane (2,2,4-trimethylpentane)	NA	NV		na	NA	3.50E+05		na
Heptane	NA	NV		na	NA	1.80E+06		na
Trichloroethane	NA	1.04E+03		na	NA	1.94E+06		na
Ethyl Acrylate	NA	1.40E-01		na	NA	6.14E+04		na

Table D-1: Comparison of Air Concentrations With Health-Based Values

Compound	Cartridge, 0.50 caliber, Ball, M33 (M2) DODIC: A552							
	$C_{chronic}$ ($\mu g/m^3$)	Health-Based Screening Level ($\mu g/m^3$)	$C_{chronic}$/ HBSL	> 1?	C_{acute} ($\mu g/m^3$)	Acute Toxicity Value ($\mu g/m^3$)	C_{acute}/ ATV	> 1?
1,2-Dichloropropane	NA	9.89E-02		na	NA	5.08E+05		na
Methyl Methacrylate	NA	7.30E+02		na	NA	4.09E+05		na
Dibromomethane	NA	3.65E+01		na	NA	2.50E+05		na
1,4-Dioxane	NA	6.11E-01		na	NA	9.00E+04		na
Bromodichloromethane	NA	1.08E-01		na	NA	4.00E+03		na
4-Methyl-2-Pentanone	NA	8.34E+01		na	NA	3.07E+05		na
Toluene	6.22E-04	4.02E+02	1.55E-06	no	1.66E-01	1.88E+05	8.87E-07	no
Octane	NA	NV		na	NA	NA		na
trans-1,3-Dichloropropene	NA	5.17E-02		na	NA	NA		na
Ethyl Methacrylate	NA	3.29E+02		na	NA	NA		na
1,1,2-Trichloroethane	NA	1.20E-01		na	NA	1.64E+05		na
Tetrachloroethene	NA	3.31E+00		na	NA	6.78E+05		na
2-Hexanone	NA	5.11E+00		na	NA	4.09E+04		na
Dibromochloromethane	NA	8.00E-02		na	NA	6.00E+03		na
1,2-Dibromoethane	NA	8.73E-03		na	NA	1.54E+05		na
Chlorobenzene	NA	6.21E+01		na	NA	1.38E+05		na
1,1,1,2-Tetrachloroethane	NA	2.60E-01		na	NA	5.15E+04		na
Ethylbenzene	4.56E-05	1.06E+03	4.31E-08	no	4.88E-02	5.43E+05	9.00E-08	no
m&p-Xylene	6.32E-05	7.30E+02	8.66E-08	no	6.77E-02	6.51E+05	1.04E-07	no
o-Xylene	5.84E-05	7.30E+02	7.99E-08	no	6.24E-02	6.51E+05	9.59E-08	no
Styrene	2.03E-04	1.06E+03	1.92E-07	no	5.43E-02	2.13E+05	2.55E-07	no
Bromoform	NA	1.75E+00		na	NA	6.20E+03		na
Cumene	NA	4.02E+02		na	NA	2.46E+05		na
1,1,2,2-Tetrachloroethane	NA	3.31E-02		na	NA	2.06E+04		na
1,2,3-Trichloropropane	NA	9.61E-04		na	NA	6.03E+04		na
Bromobenzene	NA	1.04E+01		na	NA	4.82E+04		na
4-Ethyltoluene	NA	NV		na	NA	1.25E+05		na
1,3,5-Trimethylbenzene	NA	6.21E+00		na	NA	3.68E+05		na
Alpha Methyl Styrene	NA	2.56E+02		na	NA	NA		na
1,2,4-Trimethylbenzene	1.92E-05	6.21E+00	3.10E-06	no	2.06E-02	1.80E+05	1.14E-07	no
1,3-Dichlorobenzene	NA	3.29E+00		na	NA	3.61E+04		na
1,4-Dichlorobenzene	NA	3.06E-01		na	NA	6.61E+05		na

Table D-1: Comparison of Air Concentrations With Health-Based Values

	Cartridge, 0.50 caliber, Ball, M33 (M2) DODIC: A552							
Compound	**$C_{chronic}$ ($\mu g/m^3$)**	**Health-Based Screening Level ($\mu g/m^3$)**	**$C_{chronic}$/ HBSL**	**> 1?**	**C_{acute} ($\mu g/m^3$)**	**Acute Toxicity Value ($\mu g/m^3$)**	**C_{acute}/ ATV**	**> 1?**
Benzyl Chloride	NA	3.96E-02		na	NA	5.20E+03		na
1,2-Dichlorobenzene	NA	2.09E+02		na	NA	3.01E+05		na
Hexachlorethane	NA	4.80E-01		na	NA	2.90E+04		na
1,2,4-Trichlorobenzene	NA	2.08E+02		na	NA	3.71E+04		na
Hexachlorobutadiene	NA	8.73E-02		na	NA	3.21E+04		na
Hydrocarbons								
Methane	1.96E-01	NV		na	2.09E+02	3.30E+06	6.34E-05	no
Ethylene	6.04E-03	NV		na	6.47E+00	4.60E+05	1.41E-05	no
Acetylene	6.78E-04	NV		na	1.81E-01	NA		na
Ethane	4.10E-03	NV		na	1.10E+00	NA		na
Propylene	1.60E-03	NV		na	4.28E-01	NA		na
Propane	NA	NV		na	NA	3.78E+06		na
Propyne (methyl acetylene)	NA	NV		na	NA	2.79E+06		na
Isobutane	NA	NV		na	NA	9.52E+05		na
1-Butene/Isobutylene (115-11-7)	NA	NV		na	NA	6.87E+06		na
1,3-Butadiene/butane	NA	3.74E-03		na	NA	2.20E+04		na
cis-butene	NA	NV		na	NA	1.72E+04		na
1-Butyne	NA	NV		na	NA	NA		na
trans-Butene	NA	NV		na	NA	1.72E+04		na
2-Butyne (crotonylene)	NA	NV		na	NA	NA		na
n-Pentane	NA	NV		na	NA	1.80E+06		na
n-Hexane	NA	2.10E+02		na	NA	5.28E+05		na
SVOCs								
n-nitrosodimethylamine	NA	1.37E-04		na	NA	2.50E+03		na
bis(2-chloroethyl)ether	NA	5.82E-03		na	NA	5.85E+04		na
phenol	NA	2.19E+03		na	NA	3.85E+04		na
2-chlorophenol	NA	1.83E+01		na	NA	5.25E+03		na
1,3-Dichlorobenzene	NA	3.29E+00		na	NA	3.61E+04		na
1,4-dichlorobenzene	NA	3.06E-01		na	NA	6.61E+05		na
1,2-dichlorobenzene	NA	2.09E+02		na	NA	3.01E+05		na
benzyl alcohol	NA	1.10E+03		na	NA	5.53E+04		na

Table D-1: Comparison of Air Concentrations With Health-Based Values

	Cartridge, 0.50 caliber, Ball, M33 (M2) DODIC: A552							
Compound	$C_{chronic}$ ($\mu g/m^3$)	Health-Based Screening Level ($\mu g/m^3$)	$C_{chronic}$/ HBSL	> 1?	C_{acute} ($\mu g/m^3$)	Acute Toxicity Value ($\mu g/m^3$)	C_{acute}/ ATV	> 1?
bis(2-chloroisopropyl)ether	NA	1.92E-01		na	NA	6.99E+04		na
2-methylphenol	NA	1.83E+02		na	NA	NA		na
hexachloroethane	NA	4.80E-01		na	NA	2.90E+04		na
n-nitroso-di-n-propylamine	NA	9.61E-04		na	NA	2.00E+02		na
4-methylphenol	NA	1.83E+02		na	NA	NA		na
nitrobenzene	NA	2.09E+00		na	NA	1.51E+04		na
isophorone	NA	7.08E+00		na	NA	2.83E+04		na
2-nitrophenol	NA	NV		na	NA	NA		na
2,4-dimethylphenol	NA	7.30E+01		na	NA	NA		na
bis(2-chloroethoxy)methane	NA	NV		na	NA	NA		na
2,4-dichlorophenol	NA	1.10E+01		na	NA	3.00E+04		na
1,2,4-trichlorobenzene	NA	2.08E+02		na	NA	3.71E+04		na
naphthalene	2.83E-04	3.13E+00	9.06E-05	no	3.03E-01	7.86E+04	3.86E-06	no
4-chloroaniline	NA	1.46E+01		na	NA	3.00E+04		na
hexachlorobutadiene	NA	8.62E-02		na	NA	3.21E+04		na
4-chloro-3-methylphenol	NA	NV		na	NA	2.00E+04		na
2-methylnaphthalene	NA	7.30E+01		na	NA	2.00E+04		na
hexachlorocyclopentadiene	NA	7.30E-02		na	NA	2.23E+02		na
2,4,6-trichlorophenol	NA	1.10E+02		na	NA	3.00E+04		na
2,4,5-trichlorophenol	NA	3.65E+02		na	NA	3.00E+04		na
2-chloronaphthalene	NA	2.92E+02		na	NA	6.00E+02		na
2-nitroaniline	NA	2.09E-01		na	NA	NA		na
Acenaphthylene	NA	NV		na	NA	2.00E+02		na
dimethylphthalate	NA	3.65E+04		na	NA	1.50E+04		na
2,6-dinitrotoluene	NA	3.65E+00		na	NA	6.00E+02		na
acenaphthene	NA	2.19E+02		na	NA	1.25E+03		na
3-nitroaniline	NA	NV		na	NA	NA		na
2,4-dinitrophenol	NA	7.30E+00		na	NA	7.50E+03		na
dibenzofuran	NA	1.46E+01		na	NA	NA		na
2,4-dinitrotoluene	NA	7.30E+00		na	NA	6.00E+02		na
4-nitrophenol	NA	2.92E+01		na	NA	3.00E+04		na
Fluorene	NA	1.46E+02		na	NA	7.50E+04		na

Table D-1: Comparison of Air Concentrations With Health-Based Values

	Cartridge, 0.50 caliber, Ball, M33 (M2) DODIC: A552							
Compound	**$C_{chronic}$ ($\mu g/m^3$)**	**Health-Based Screening Level ($\mu g/m^3$)**	**$C_{chronic}$/ HBSL**	**> 1?**	**C_{acute} ($\mu g/m^3$)**	**Acute Toxicity Value ($\mu g/m^3$)**	**C_{acute}/ ATV**	**> 1?**
4-chlorophenyl-phenylether	NA	NV		na	NA	NA		na
diethylphthalate	NA	2.92E+03		na	NA	1.50E+04		na
4-nitroaniline	NA	NV		na	NA	9.00E+03		na
4,6-dinitro-2-methylphenol	NA	3.65E-01		na	NA	5.00E+02		na
n-nitrosodiphenylamine(1)	NA	1.37E+00		na	NA	NA		na
4-bromophenyl-phenylether	NA	NV		na	NA	NA		na
hexachlorobenzene	NA	4.18E-03		na	NA	7.50E+01		na
pentachlorophenol	NA	5.60E-02		na	NA	1.50E+03		na
phenanthrene	NA	NV		na	NA	2.00E+03		na
anthracene	NA	1.10E+03		na	NA	6.00E+03		na
di-n-butylphthalate	3.20E-04	3.65E+02	8.76E-07	no	3.42E-01	1.50E+04	2.28E-05	no
fluoranthene	NA	1.46E+02		na	NA	3.00E+01		na
pyrene	NA	1.10E+02		na	NA	1.50E+04		na
butylbenzylphthalate	NA	7.30E+02		na	NA	5.00E+05		na
benzo(a)anthracene	NA	2.17E-02		na	NA	6.00E+02		na
chrysene	NA	2.17E+00		na	NA	2.00E+02		na
3,3-dichlorobenzidine	NA	1.50E-02		na	NA	6.21E+03		na
bis(2-ethylhexyl)phthalate	4.17E-03	4.80E-01	8.67E-03	no	1.04E+01	1.00E+04	1.04E-03	no
di-n-octylphthalate	NA	7.30E+01		na	NA	1.50E+05		na
benzo(b)fluoranthene	NA	2.17E-02		na	NA	NA		na
benzo(k)fluoranthene	NA	2.17E-01		na	NA	NA		na
benzo(a)pyrene	NA	2.17E-03		na	NA	7.50E+03		na
indeno(1,2,3-cd)pyrene	NA	2.17E-02		na	NA	NA		na
dibenz(a,h)anthracene	NA	2.17E-03		na	NA	3.00E+04		na
benzo(g,h,i)perylene	NA	NV		na	NA	3.00E+04		na
TO-13 (PAHs)								
naphthalene	2.02E-04	3.13E+00	6.47E-05	no	2.17E-01	7.86E+04	2.76E-06	no
acenaphthylene	1.10E-05	NV		na	1.17E-02	2.00E+02	5.86E-05	no
Acenaphthene	2.38E-06	2.19E+02	1.09E-08	no	2.55E-03	1.25E+03	2.04E-06	no
fluorene	5.41E-06	1.46E+02	3.70E-08	no	5.78E-03	7.50E+04	7.71E-08	no
phenanthrene	5.67E-06	NV		na	6.07E-03	2.00E+03	3.04E-06	no

Table D-1: Comparison of Air Concentrations With Health-Based Values

Compound	Cartridge, 0.50 caliber, Ball, M33 (M2) DODIC: A552							
	$C_{chronic}$ ($\mu g/m^3$)	Health-Based Screening Level ($\mu g/m^3$)	$C_{chronic}$/ HBSL	> 1?	C_{acute} ($\mu g/m^3$)	Acute Toxicity Value ($\mu g/m^3$)	C_{acute}/ ATV	> 1?
anthracene	1.15E-06	1.10E+03	1.05E-09	no	1.23E-03	6.00E+03	2.04E-07	no
fluoranthene	4.86E-06	1.46E+02	3.33E-08	no	5.20E-03	3.00E+01	1.73E-04	no
pyrene	1.30E-05	1.10E+02	1.19E-07	no	1.39E-02	1.50E+04	9.28E-07	no
benzo(a)anthracene	1.15E-06	2.17E-02	5.32E-05	no	2.88E-03	6.00E+02	4.80E-06	no
chrysene	1.43E-06	2.17E+00	6.59E-07	no	3.57E-03	2.00E+02	1.78E-05	no
benzo(b)fluoranthene	1.79E-06	2.17E-02	8.24E-05	no	1.12E-03	NA		na
benzo(k)fluoranthene	8.19E-07	2.17E-01	3.78E-06	no	5.11E-04	NA		na
Benzo(e)pyrene	8.52E-06	NV		na	2.28E-03	NA		na
benzo(a)pyrene	2.54E-06	2.17E-03	1.17E-03	no	6.33E-03	7.50E+03	8.44E-07	no
indeno(1,2,3-cd)pyrene	2.01E-06	2.17E-02	9.27E-05	no	1.25E-03	NA		na
dibenz(a,h)anthracene	2.01E-07	2.17E-03	9.27E-05	no	5.02E-04	3.00E+04	1.67E-08	no
benzo(g,h,i)perylene	2.08E-05	NV		na	2.23E-02	3.00E+04	7.43E-07	no
Dioxins and Furans								
2378-Tetrachlorodibenzo-p-dioxin	NA	4.48E-08		na	NA	3.50E+00		na
12378-Pentachlorodibenzo-p-dioxin	NA	NV		na	NA	2.50E+00		na
123478-Hexachlorodibenzo-p-dioxin	NA	NV		na	NA	NA		na
123678-Hexachlorodibenzo-p-dioxin	NA	NV		na	NA	1.50E+01		na
123789-Hexachlorodibenzo-p-dioxin	NA	1.48E-06		na	NA	NA		na
1234678-Heptachlorodibenzo-p-dioxin	1.21E-10	NV		na	3.24E-08	NA		na
OCDD	9.38E-10	NV		na	1.00E-06	1.50E+02	6.69E-09	no
2378-Tetrachlorodibenzo-p-furan	NA	NV		na	NA	2.00E+00		na
12378-Pentachlorodibenzo-p-furan	NA	NV		na	NA	NA		na
23478-Pentachlorodibenzo-o-furan	NA	NV		na	NA	7.50E-02		na
123478-Hexachlorodibenzo-p-furan	NA	NV		na	NA	7.50E+00		na
123678-Hexachlorodibenzo-p-furan	NA	NV		na	NA	2.50E+00		na
123789-Hexachlorodibenzo-p-furan	NA	NV		na	NA	NA		na
234678-Hexachlorodibenzo-p-furan	NA	NV		na	NA	1.50E+00		na
1234678-Heptachlorodibenzo-p-furan	5.48E-11	NV		na	1.47E-08	NA		na
1234789-Heptachlorodibenzo-p-furan	NA	NV		na	NA	NA		na
OCDF	1.53E-10	NV		na	1.63E-07	3.00E+02	5.44E-10	no
Energetics								
Nitrobenzene	NA	2.09E+00		na	NA	1.51E+04		na

Table D-1: Comparison of Air Concentrations With Health-Based Values

	Cartridge, 0.50 caliber, Ball, M33 (M2) DODIC: A552							
Compound	**$C_{chronic}$ ($\mu g/m^3$)**	**Health-Based Screening Level ($\mu g/m^3$)**	**$C_{chronic}$/ HBSL**	**> 1?**	**C_{acute} ($\mu g/m^3$)**	**Acute Toxicity Value ($\mu g/m^3$)**	**C_{acute}/ ATV**	**> 1?**
2-Nitrotoluene	NA	3.65E+01		na	NA	NA		na
3-Nitrotoluene	NA	3.65E+01		na	NA	NA		na
4-Nitrotoluene	NA	3.65E+01		na	NA	3.37E+04		na
Nitroglycerine	NA	4.80E-01		na	NA	NA		na
1,3-Dinitrobenzene	NA	3.65E-01		na	NA	3.00E+03		na
2,6-Dinitrotoluene	NA	3.65E+00		na	NA	6.00E+02		na
2,4-Dinitrotoluene	NA	7.30E+00		na	NA	6.00E+02		na
1,3,5-Trinitrobenzene	NA	1.10E+02		na	NA	3.00E+04		na
2,4,6-Trinitrotoluene	NA	2.24E-01		na	NA	2.50E+04		na
RDX	NA	6.11E-02		na	NA	NA		na
4-Amino-2,6-Dinitrotoluene	NA	NV		na	NA	NA		na
2-Amino-2,6-Dinitrotoluene	NA	NV		na	NA	1.50E+04		na
Tetryl	NA	3.65E+01		na	NA	NA		na
HMX	NA	1.83E+02		na	NA	NA		na
Pentaerythritoltetranitrate	NA	NV		na	NA	5.00E+01		na
Dibutyl Phthalate	NA	3.65E+02		na	NA	1.50E+04		na
Dioctyl Phthalate	NA	4.80E-01		na	NA	1.00E+04		na
Diphenylamine	NA	9.13E+01		na	NA	3.00E+04		na

Footnotes:
NA: Not applicable because compound was not detected.
na: Not available because health-based sceening value is not available or not applicable if compound was not detected.
NV: No value available.
$C_{chronic}$: Chronic time-averaged concentration
HBSL: Chronic health-based screening level
C_{acute}: acute concentration
ATV: Acute toxicity value

Table D-2: Comparison of Air Concentrations With Health-Based Values: Total Petroleum Hydrocarbons

	Cartridge, 0.50 caliber, Ball, M33 (M2) Bodic, A552			
Compound	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)	$C_{chronic}$ (µg/m^3)
	Aliphatic:C<=8	*Aliphatic:C>8*	*Aromatic:C<=8*	*Aromatic:C>8*
Pentane	3.41E-05	NA	NA	NA
Hexane	1.20E-03	NA	NA	NA
Benzene	NA	NA	6.08E-03	NA
Toluene	NA	NA	6.22E-04	NA
Ethylbenzene	NA	NA	4.56E-05	NA
m&p-Xylene	NA	NA	6.32E-05	NA
o-Xylene	NA	NA	5.84E-05	NA
Styrene	NA	NA	NA	2.03E-04
1,2,4-Trimethylbenzene	NA	NA	NA	1.92E-05
Propylene	1.60E-03	NA	NA	NA
naphthalene	NA	NA	NA	2.83E-04
naphthalene	NA	NA	NA	2.02E-04
acenaphthylene	NA	NA	NA	1.10E-05
Acenaphthene	NA	NA	NA	2.38E-06
fluorene	NA	NA	NA	5.41E-06
phenanthrene	NA	NA	NA	5.67E-06
anthracene	NA	NA	NA	1.15E-06
fluoranthene	NA	NA	NA	4.86E-06
Total (µg/m^3)	2.84E-03	0.00E+00	6.87E-03	7.38E-04
Derived Health-Based Screening Level	1.92E+04	1.04E+03	4.17E+02	2.09E+02
$C_{chronic}$/HBSL	1.48E-07	0.00E+00	1.65E-05	3.54E-06
>1?	no	no	no	no

Footnotes:
>1? = Is the ratio greater than one?
NA = Not Applicable because compound was not detected
$C_{chronic}$ = chronic averaged air Concentration
HBSL = Health-Based Screening Level

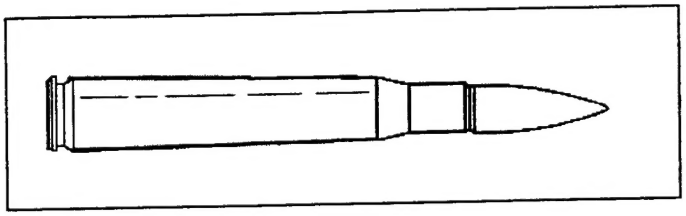
APPENDIX E

FACT SHEET SUBMITTED TO THE U.S. ARMY ENVIRONMENTAL CENTER

U.S. Army Environmental Center
Training Munitions Fact Sheet

M33 .50 Caliber Ball Cartridge
Department of Defense Identification Code: A552

Breathing air emissions from the M33 .50 caliber ball cartridge will not impact the health of residents who live near Army training facilities.



To be fully prepared to protect our country, U.S. soldiers must train with many different weapons and munitions, including the M33 .50 caliber ball cartridge. This training is important because it helps prepare our soldiers for a variety of combat situations. While the Army recognizes the value of such comprehensive training on our installations, we also work hard to ensure the safety and health of surrounding communities.

Will Breathing Air Emissions From The M33 .50 Caliber Ball Cartridge Affect My Health?

To answer this question, the U.S. Army tested the air emissions that are released when the M33 is fired. The information gathered during these tests was then analyzed to determine if there would be a potential for health effects from inhalation to residents who live near training areas. Study results, generated using conservative methods, showed that offsite residents breathing air as close as 100 meters (328 feet or about the length of a football field) from the firing location are safe from these emissions. At most locations, training areas are at least 1,000 meters (over half a mile) away from populated areas and the distance to firing locations may be even farther.

How Was The Study Conducted?

To gather data for this study, the M33 was fired from the M2 machine gun in a test chamber. The air in the chamber was then tested to identify the types and amounts of substances released. About 300 different substances were looked for during this part of the study.

This information was then used in an U.S. Environmental Protection Agency (USEPA) approved air model (a computer program that allows estimation of air concentrations) to determine the amount of each substance to which someone

living near a training site might be exposed. Downwind concentrations were estimated based on a typical use scenario for the M33 during training exercises. Since this study did not look at any one specific training area, the assumptions used in the model would, in most cases, predict higher downwind air concentrations than those expected at an actual training site.

These estimated air concentrations were then compared to screening levels established by the U.S. Environmental Protection Agency and other federal agencies. If the air concentrations are below these screening levels, they are considered safe for the general population, including sensitive people such as the sick, elderly, and children.

What Are The Study Limitations?

Many steps were taken to ensure that the results of this study are protective of residents who live near training facilities. However, as with any study, this study has limitations. For example, the study does not consider exposure to other types of munitions that could also be used during the same training event. Due to these limitations, conservative model conditions were used to ensure the protection of public health from breathing M33 air emissions.

What Exactly Is The M33 .50 Caliber Ball Cartridge?

The M33 is a type of ball ammunition, which means that it is intended for use against unarmored targets. The M33 has a brass cartridge case and a bullet with a brass jacket. It also contains a propelling charge that consists mostly of nitrocellulose. Nitrocellulose is the primary ingredient in smokeless propellant (for both military and commercial use) and is also used in the production of lacquers and artificial leathers. Each M33 cartridge is about as long as a pen and weighs less than half a pound. The M33 does not have any specific markings and is generally identified by its plain bullet tip.

Where Can I Get More Information?

For more information on the M33 or other military munitions, please call the Army Environmental Hotline at 1-800-USA-3845, visit our Web site at www.aec.army.mil, or e-mail t2hotline@aec.apgea.army.mil.